Concrete Recycling

Sand & Gravel General Permit
Preliminary Draft Language

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Sand & Gravel General Permit Writer

Water Quality Program

DEPARTMENT OF ECOLOGY
State of Washington

Presentation Agenda

- Introduction
- Current Status
- Benefits & Uses
- Water Quality Concerns
- Current Permit Approach
- Preliminary Draft Permit Language
- Questions & Discussion

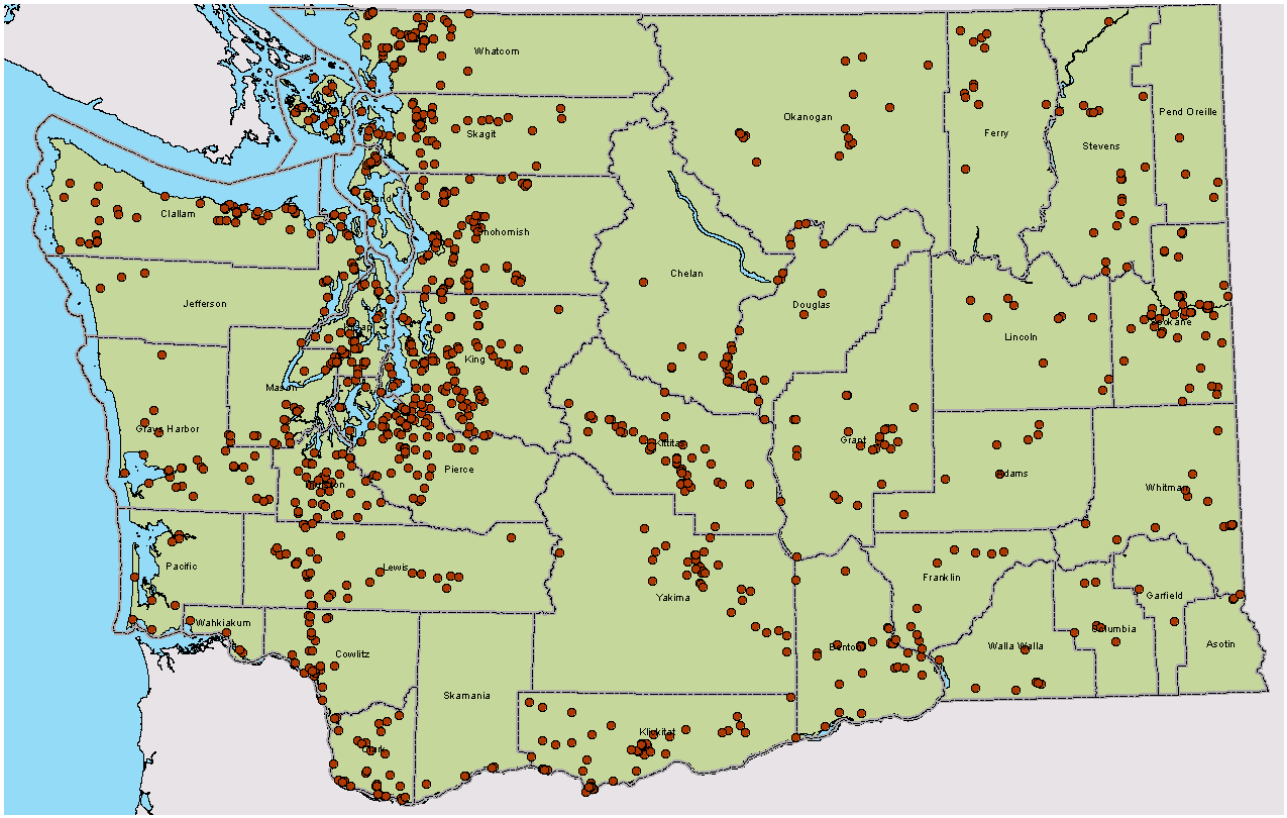
Ecology's Commitment

Ecology is committed to supporting concrete recycling that is done in a manner that is protective of the environment and water quality

Current Status

Permittees Status

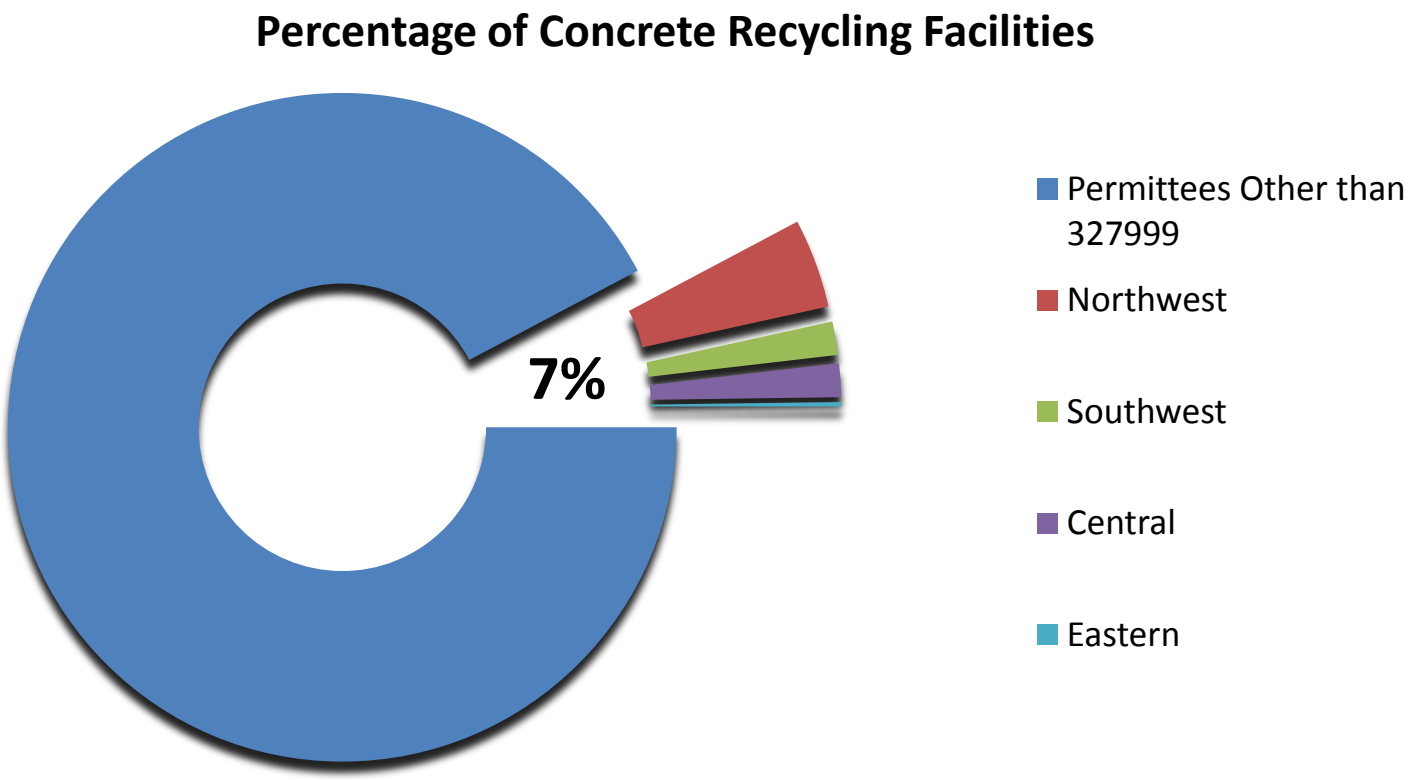
- 929 Sand & Gravel facilities across Washington State



Permittees Status

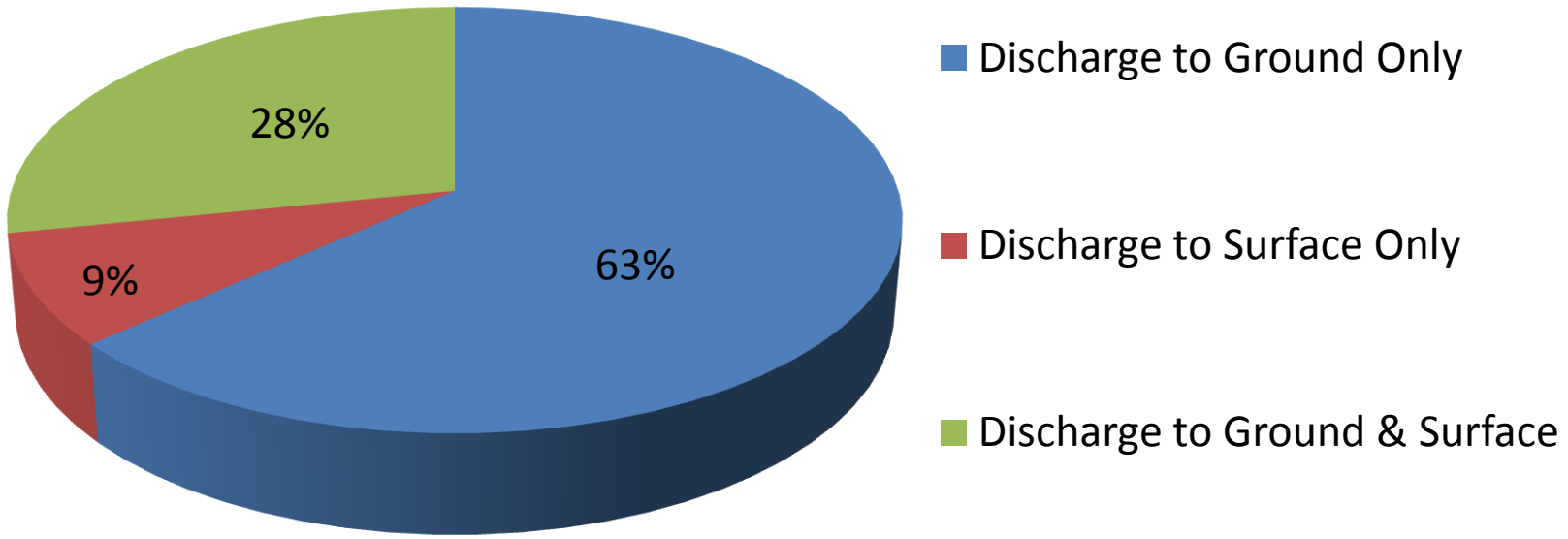
71Sand & Gravel Facilities have the NAICS Code 327999

(All Other Miscellaneous Nonmetallic Mineral Product Manufacturing)



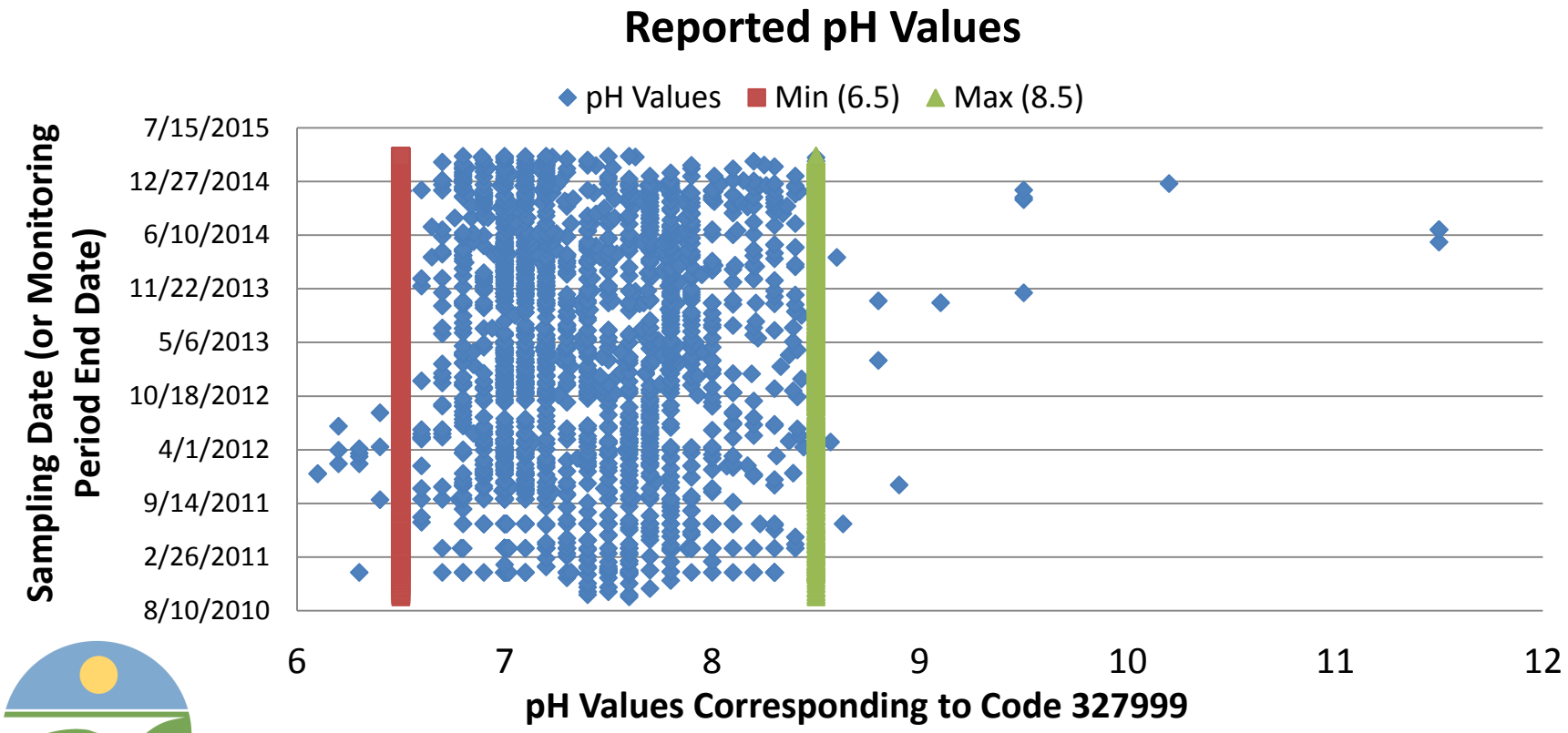
Permittees Status

- 91% discharge to ground



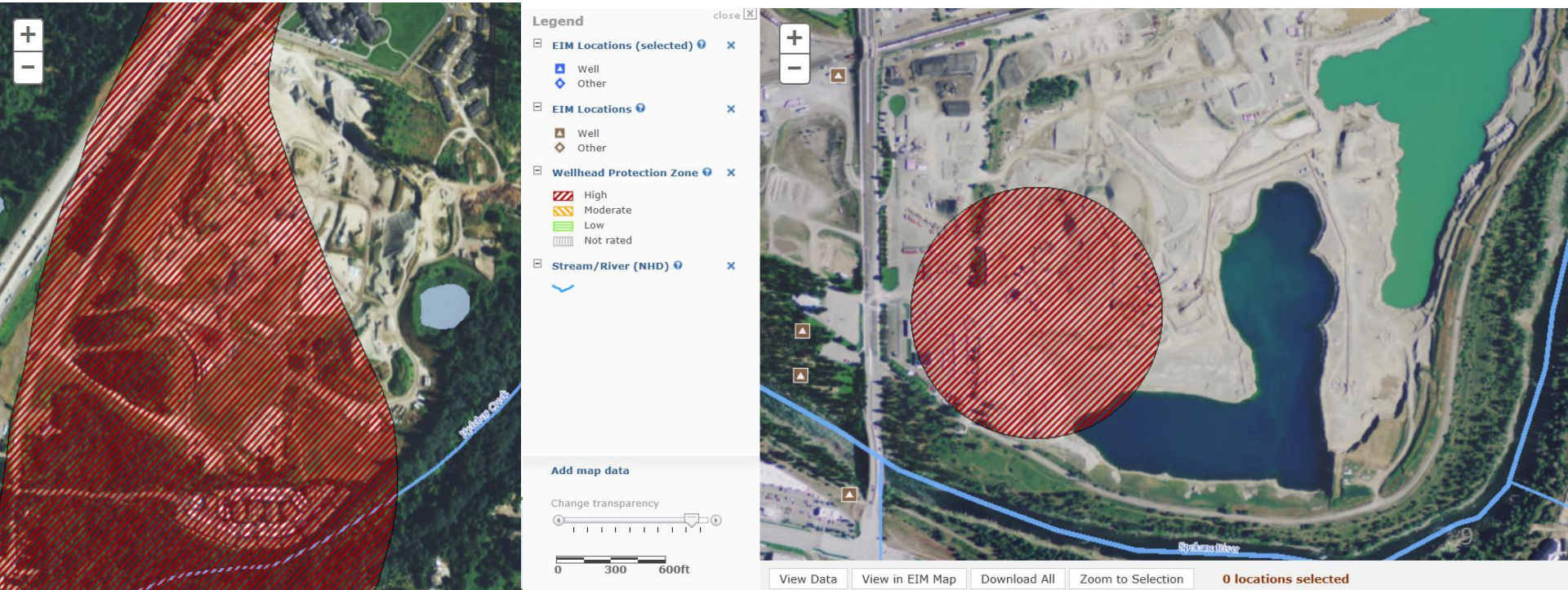
Permittees Status

- 28 numeric violations
- 6.1 - 11.5 pH values reported on DMRs



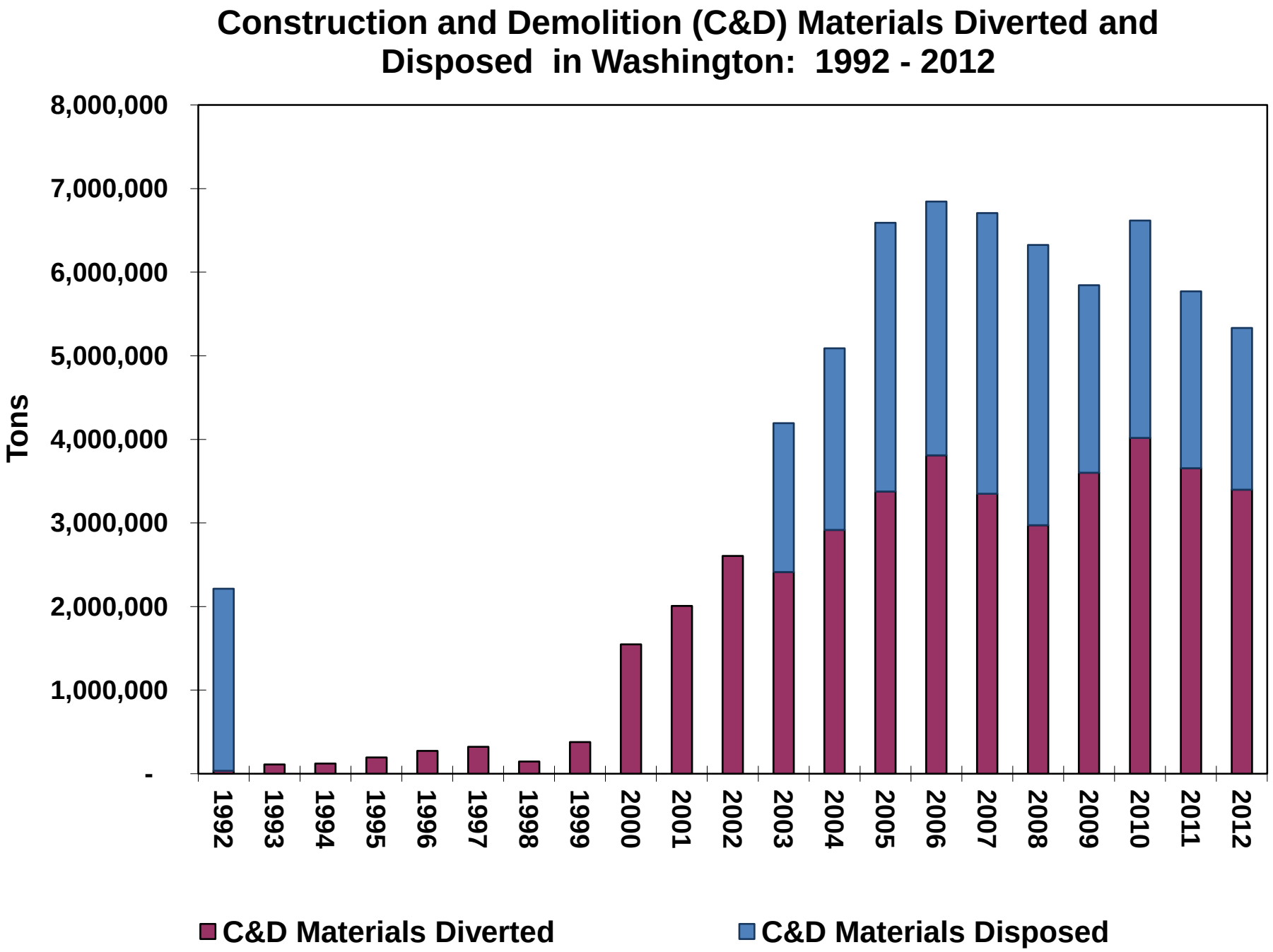
Permittees Status

- 54 (76%) are located near a surface waterbody
- 22 (31%) are located in a wellhead protection zone



Industry Status

- Demolition of concrete pavements and structures is the major source of concrete for recycling
- 1,007,851 tons of concrete waste generated by Washingtonians in 2012
- 87.7%, or 883,799 tons of waste concrete was diverted for recycling


Construction and Demolition (C&D) Materials Diverted and Disposed in Washington: 1992 - 2012
Tons
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
C&D Materials Diverted
C&D Materials Disposed

2015 New Recycling Law

- Established reuse & recycling of construction aggregate and recycled concrete materials as a priority
- WSDOT must use a minimum of 25% on its infrastructure projects
- Local governments must take into account recycled concrete percentages when awarding bids

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Benefits & Uses

Benefits

- Decreases landfill waste
- Reuses valuable aggregate
- Conserves new aggregate
- Reduces green house gas emissions
  - The 3.7 million tons of C&D debris diverted from landfills prevented over 200,000 tons of green house gas emissions
- Reduces illegal dumping

Uses

- Reuse in new portland cement concrete (PCC)
- Most studies recommend 30% replacement within concrete mixes (some state agencies allow 100%)

Compressive strength	Tensile strength	Modulus of elasticity	Drying shrinkage	Creep	Permeability	Freeze-thaw resistance	Depth of carbonation
⇔	⇔	⇓	⇑[2]	⇑[2]	⇔	⇔	⇔

[1]Compared to the properties of reference concrete containing natural aggregate with the same water-to-cement ratio.
[2]Effect especially pronounced with increasing amount of fine recycled aggregate.

Table from Portland Cement Association, *Concrete Technology Today*, July 2002

Uses

- There are many possible uses for recycled concrete aggregates
- Common uses include:
  - Backfill
  - Base Course
  - Subbase
  - Ballast
- Any place you normally use aggregate is a potential opportunity

Washington State Department of Transportation 2014 *Standard Specifications for Road, Bridge, and Municipal Construction*. M 41-10.

9-03.21(1)E Table on Maximum Allowable Percent (By Weight) of Recycled Material

Maximum Allowable Percent (by weight) of Recycled Material					
		Hot Mix Asphalt	Concrete Rubble	Recycled Glass (glass cullet)	Steel Furnace Slag
Fine Aggregate for Portland Cement Concrete	9-03.1(2)	0	0	0	0
Coarse Aggregates for Portland Cement Concrete	9-03.1(4)	0	0	0	0
Aggregates for Hot Mix Asphalt	9-03.8	See 5-04.2	0	0	20
Ballast	9-03.9(1)	20	100	20	20
Permeable Ballast	9-03.9(2)	20	100	20	20
Crushed Surfacing	9-03.9(3)	20	100	20	20
Aggregate for Gravel Base	9-03.10	20	100	20	20
Gravel Backfill for Foundations – Class A	9-03.12(1)A	20	100	20	20
Gravel Backfill for Foundations – Class B	9-03.12(1)B	20	100	20	20
Gravel Backfill for Walls	9-03.12(2)	0	100	20	20
Gravel Backfill for Pipe Zone Bedding	9-03.12(3)	0	100	20	20
Gravel Backfill for Drains	9-03.12(4)	0	100	20	0
Gravel Backfill for Drywells	9-03.12(5)	0	0	20	0
Backfill for Sand Drains	9-03.13	0	100	20	0
Sand Drainage Blanket	9-03.13(1)	0	100	20	0
Gravel Borrow	9-03.14(1)	20	100	20	20
Select Borrow	9-03.14(2)	20	100	20	20
Select Borrow (greater than 3 feet below Subgrade and side slopes)	9-03.14(2)	100	100	20	20
Common Borrow	9-03.14(3)	20	100	20	20
Common Borrow (greater than 3 feet below Subgrade and side slopes)	9-03.14(3)	100	100	20	20
Foundation Material Class A and Class B	9-03.17	0	100	20	20
Foundation Material Class C	9-03.18	0	100	20	20
Bank Run Gravel for Trench Backfill	9-03.19	20	100	20	20

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  - Concrete Recycling Stockpiles
- Current Permit Approach
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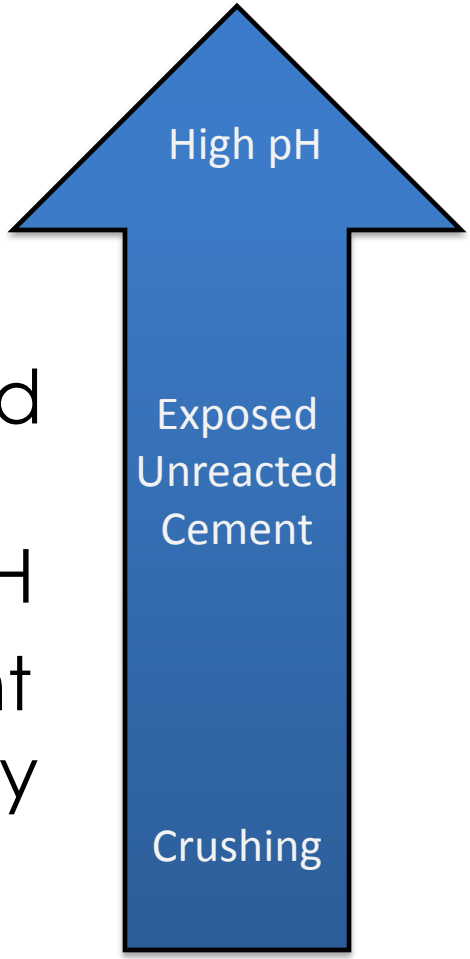
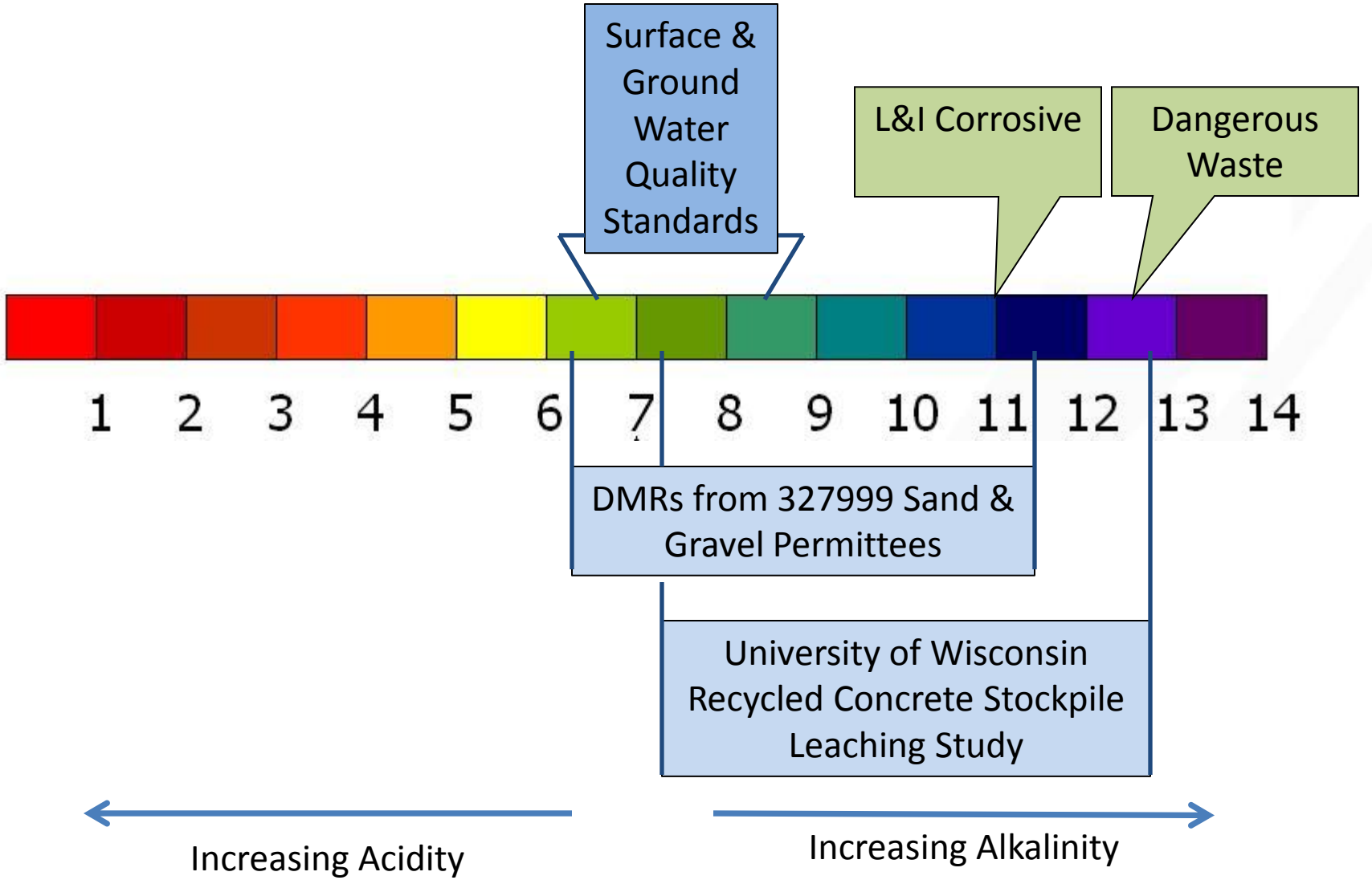
Water Quality Concerns

Water Quality Concerns

- Crushing or fracturing hardened concrete exposes unreacted quicklime or cement
- When water contacts the unreacted quicklime or cement chemical reactions occur that result in high pH
- Stormwater, erosion, and movement within the stockpile can continuously expose new potential reaction sites



Alkaline pH Scale



Water Quality Standards

- Process water and runoff from Concrete Recycling Stockpiles has the potential to:
  - Exceed the criteria of Chapter 173-200 WAC, Water Quality Standards for Ground Waters of the State of Washington
  - Exceed the fresh and marine criteria of Chapter 173-201A WAC, Water Quality Standards for Surface Waters of the State of Washington

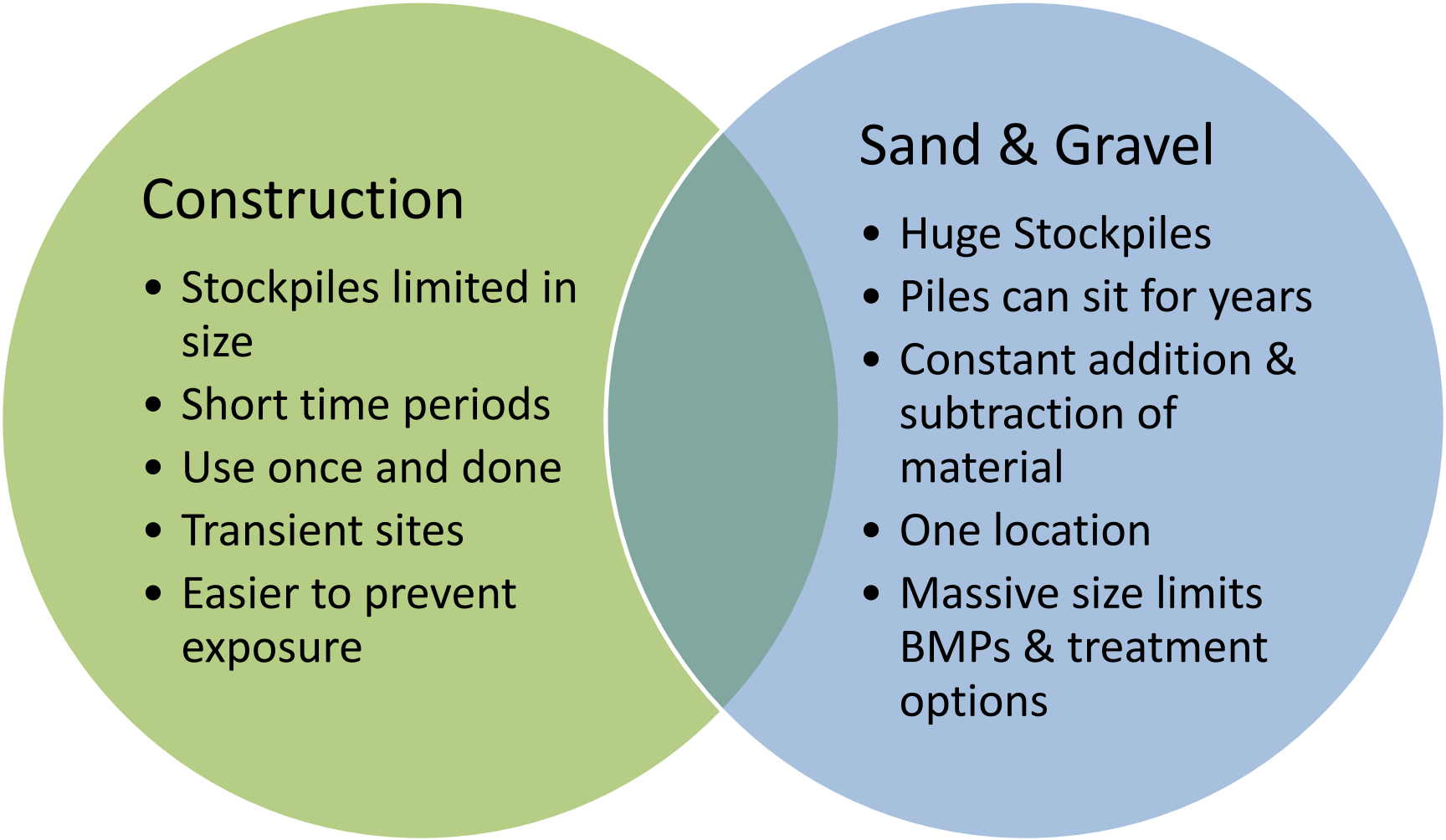
Water Quality Concerns

CONCRETE RECYCLING STOCKPILES

Concrete Recycling Stockpiles

- Stockpiles are big:
  - 7 acres of crushed concrete
  - Millions of tons
- Stockpiles contain both fines and monolithic blocks
- Stockpiles can sit for years

Concrete Recycling Stockpiles



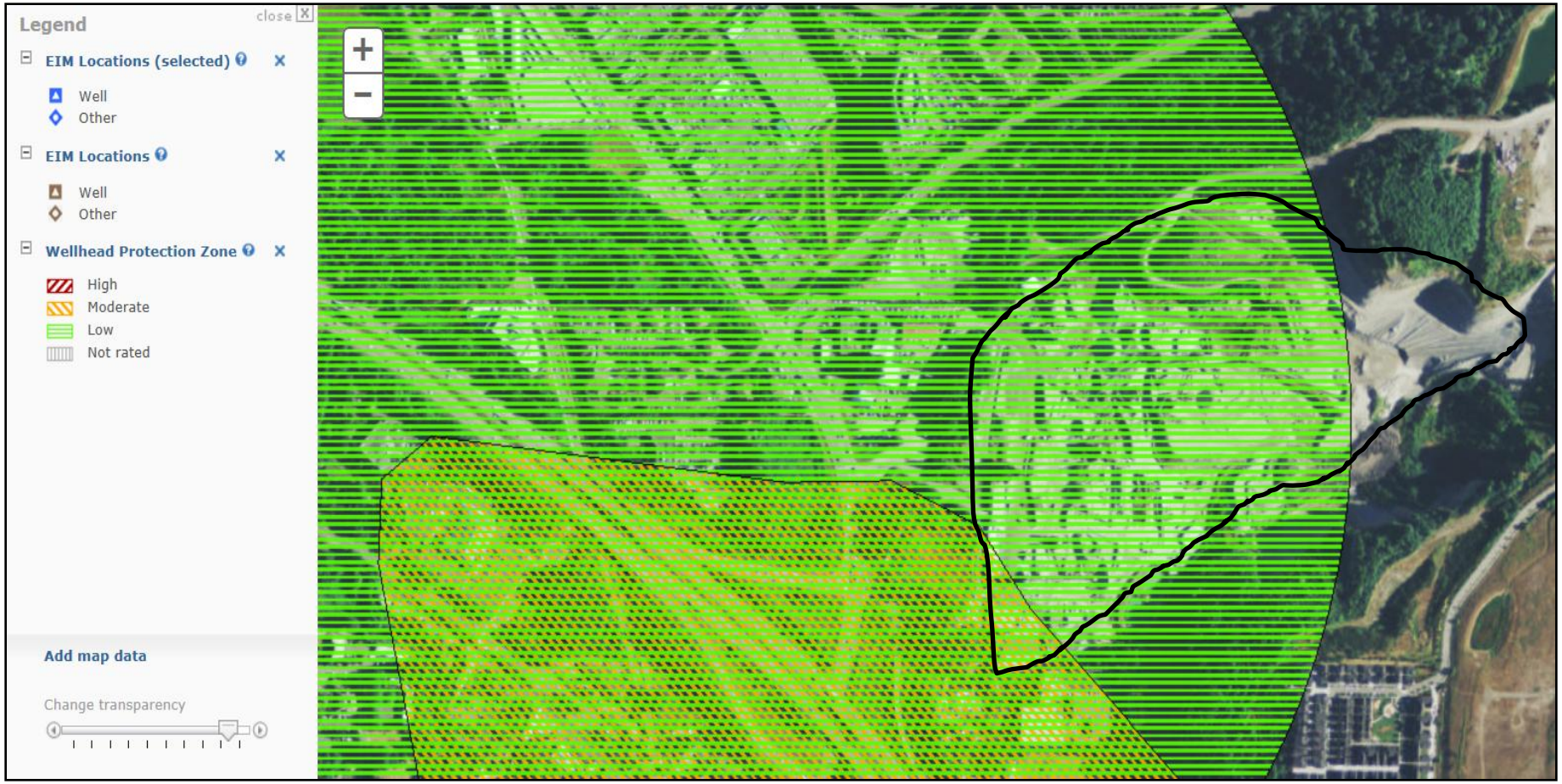
Stockpiles Located in Wellhead Protection Zones

- A wellhead protection zone is the surface & subsurface area surrounding a well that contaminants are likely to pass through
- Time-of-travel criteria defines the primary zones of wellhead protection

Stockpiles Located in Wellhead Protection Zones

- WAC 173-200-090
  - Wellhead protection areas may be classified as "Special Protection Areas"
- WAC 246-290-130 and 246-290-135 set requirements for wellhead protection areas
- Pollution prevention is the state's preferred approach to groundwater protection

Stockpiles Located in Wellhead Protection Zones



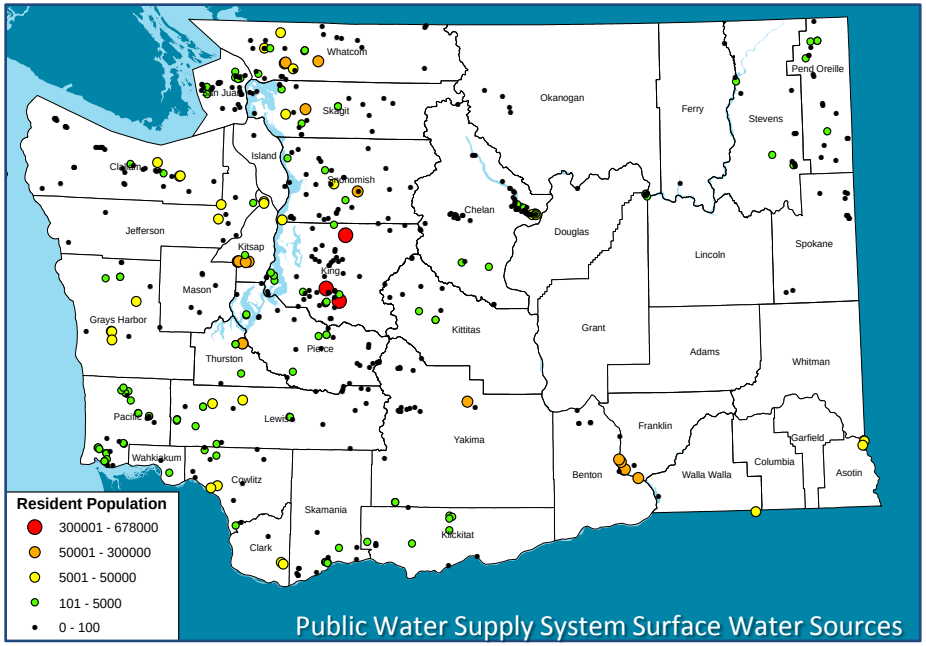
Stockpiles Located Near Surface Water Bodies

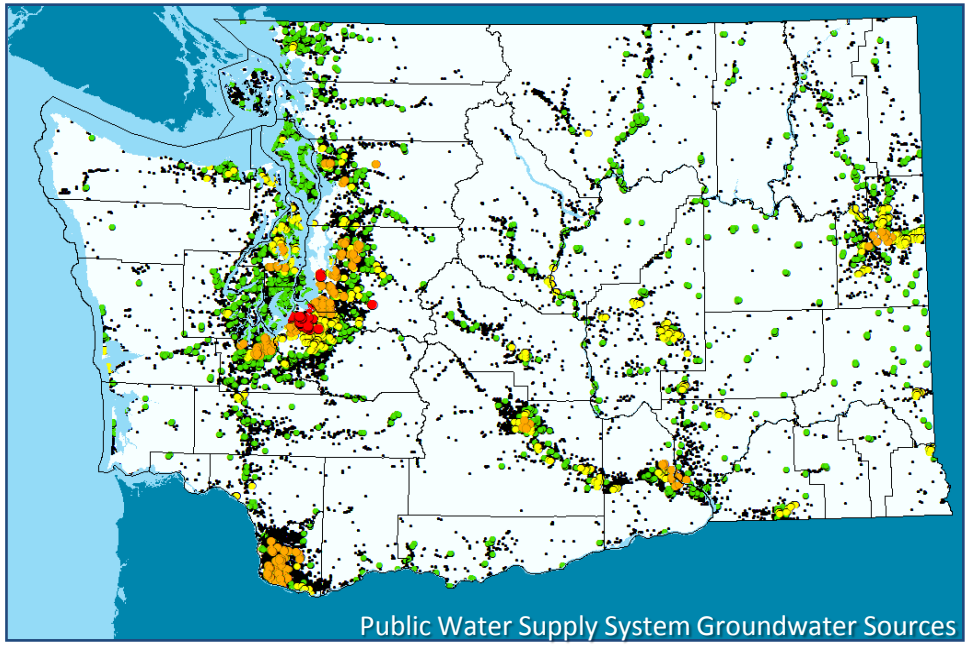
Water Quality Concerns

- Protect aquatic life
- pH determines the solubility and biological availability of metals and other contaminants
  - Arsenic
  - Selenium
- Clogging of drainage systems

Water Quality Concerns

- Protect domestic water supply sources
  - Affects to collection & treatment systems
  - More costly and difficult to treat drinking water with a high pH





Data Source: Washington Dept. of Health Drinking Water Program

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Current Permit Approach

Current Permit

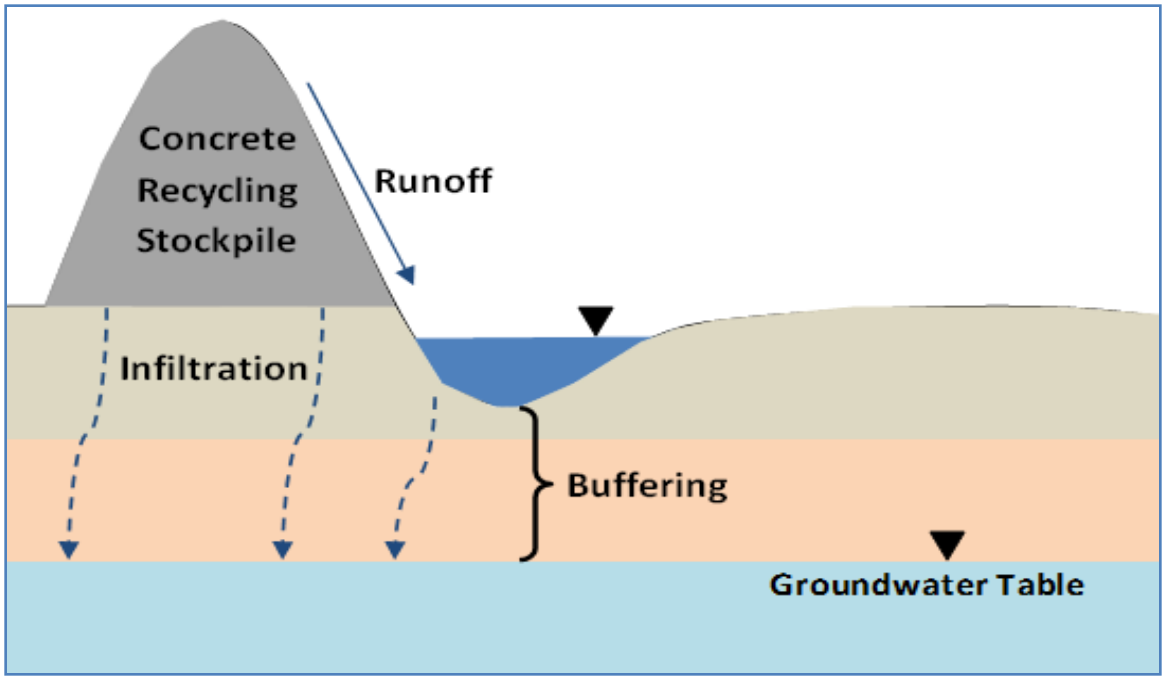
- Monthly monitoring
- Effluent limits are for both stormwater and process water
- Effluent limits for both surface and ground
- pH effluent limit of 6.5 – 8.5
- Permittees can monitor in puddles and infiltration ponds

Point of Compliance

- Permittees can monitor in puddles and infiltration ponds or in groundwater monitoring wells
- Water ponding at a facility can be considered a discharge to groundwater
- WAC 173-200-060 establishes the point of compliance within the groundwater

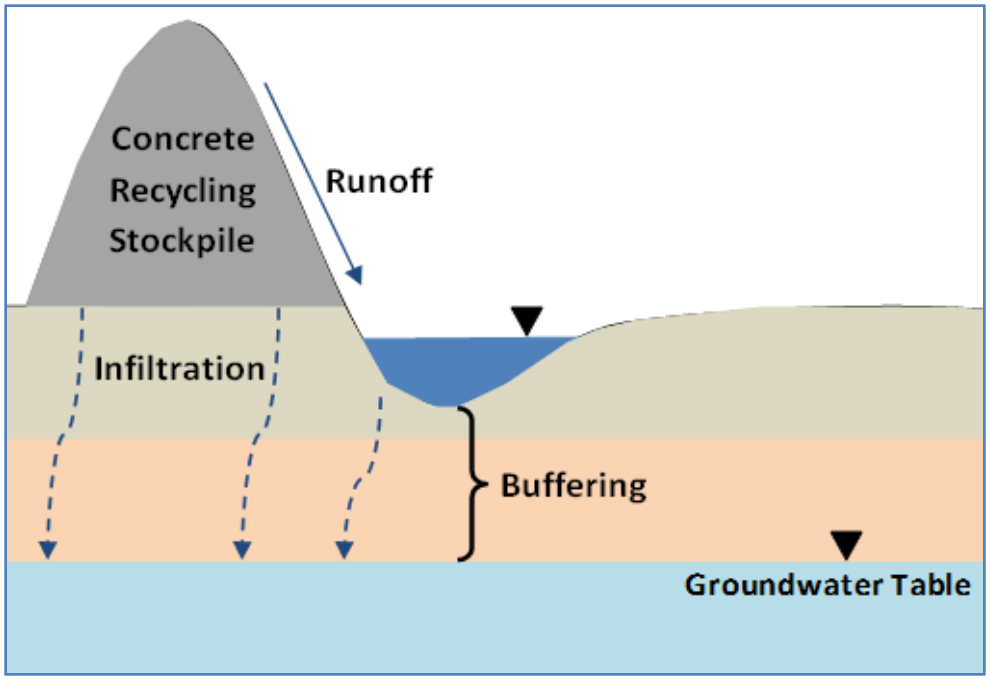
Point of Compliance Concerns

- Between the puddle on the ground and the groundwater table the soil can buffer high pH runoff



Point of Compliance Concerns

- Buffering is site specific & dependent on:
  - Geochemistry
  - Distance between the bottom of the stockpile and the groundwater table
  - Characteristics of the runoff
  - Hydrogeology (presence of compacted soils, till, and hardrock)



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Current Permit

- Monthly monitoring
- Effluent limits are f
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  in ds

NO CHANGES PROPOSED

Preliminary Draft Permit Language

Preliminary Draft Permit Language

- Pollution Prevention Schedule
- New BMPs
- Concrete Recycling Definition

Preliminary Draft Permit Language

- Defined response in the rare case that permittees have a concrete recycling wastewater discharge that has a pH higher than 8.5
  - Keeps permittees in compliance
  - Establish consistency across the state
  - Sets expectations
  - Takes specific site conditions into account
  - Provides flexibility

Preliminary Draft Permit Language

- Focus on discharges to ground
- Less concerned about discharges to surface
  - Water is collected and treated prior to discharge
  - Fewer facilities discharge to surface waters
  - Washington surface waters resist pH changes (are well buffered)

Preliminary Draft Permit Language

- New BMPs for placing of concrete recycled stockpiles
  - Protects surface water
  - Protects drinking water
- New BMP for materials acceptance
  - Reduces permittees liability
  - Limits risks associated with dangerous waste
- Omissions & substitutions allowed with rationale

New Definition

- Focuses on the activity not the material
- Focuses on hardened instead of cured
  - Curing times are different for different products
  - Curing is an ongoing process without a defined end point
- Focuses on structural concrete
  - Best source for recycling
  - Less risk for other contaminants

Preliminary Draft Permit Language

- Concrete Recycling Definition
- Code Classification
- Pollution Prevention Schedule
- New BMPs

New Definition

Concrete Recycling means the processing (including, but not limited to, crushing, fracturing, sorting, storing, stockpiling, grading, and washing) of hardened structural concrete to produce a reusable concrete product.

New Definition

- Concrete Recycling:
  - Demolished structures
  - Demolished roads
  - Comeback concrete after it has been ribboned out and has hardened

- Not Concrete Recycling
  - Comeback concrete
  - Drilling slurries
  - Unhardened Construction Washout Containers
  - Concrete truck washout

Preliminary Draft Permit Language

- Concrete Recycling Definition
- Code Classification
- Pollution Prevention Schedule
- New BMPs

New Code ECY002

- Concrete recycling currently included under NAICS 327999
- Ecology proposes to add a new code (ECY002) specifically for concrete recycling
  - Separating these codes allows Ecology to calculate fees easier
    - Fees for recycled concrete are less than for ready-mix concrete

New Code ECY002

- NAICS doesn't have a specific code for concrete recycling
  - Purpose of NAICS is to collect and analyze U.S. business economy data, not for establishing environmental requirements
  - NAICS classifies recycling by the products that they become
  - There isn't a single code that is a good fit

New Code ECY002

- Allows gathering of compliance data
  - Shows consistent compliance of industry
  - Helps inform future permit decisions
- Focus on a specific industry segment instead of all concrete related NAICS codes
  - Risk of high pH runoff higher for concrete recycling than for ready-mix
  - Establish requirements only for the applicable industry segment

Process Water Effluent Limits

S2. EFFLUENT LIMITS

Table 1: Effluent Limits and Monitoring Requirements for Process Water and Mine Dewatering Water

Type	*NAICS* Code (see Appendix A)	Discharge to:	*pH*		*Turbidity (NTU)*		*Total Suspended Solids (TSS)*	Oil Sheen [3]	Discharge Flow (*gpm*)	*Total Dissolved Solids (TDS)*
			Min	Max	*Average Monthly*	Maximum Daily	*Average Quarterly*			
Process Water, Mine Dewatering Water	327320, 327331 327332, 327390, 327999, ECY002	Surface	One/Month		Two/Month[2]		Quarterly[1]	Daily when runoff occurs	see S12.A.6 and S12.A.7	
			6.5	8.5	50	50	40 mg/l	Visible Sheen	----	
		Ground	One/Month		----		----	Daily when runoff occurs	----	Monthly
			6.5	8.5[4]	----		----	Visible Sheen	----	500 mg/l

Notes for Tables 2 and 3

1. Quarterly means at least one sample in each of the periods of January to March, April to June, July to September, and October to December.
2. When required to sample *turbidity* twice a month, there must be at least 24 hours between sampling.
3. The discharge of sheen or petroleum products to *waters of the state* is a violation and must be reported as a violation. The presence of a visible sheen on *site* is not a violation if the Permittee corrects the problem in a timely manner, notes the occurrence in their Discharge Monitoring Report (DMR), and explains in the DMR the cause and describes the solution. (Also see conditions S4.F.4, S5.C, S9.C and S10.E.)
4. Permittees that have groundwater discharges associated with code ECY002 that exceed 8.5 must comply with the pollution prevention schedule in Appendix C.

Examples of Process Water Discharges

- Washing concrete recycling aggregate to remove fines
- Wetting concrete recycling stockpiles to retain moisture content & improve workability

Stormwater Effluent Limits

Table 2: Effluent Limits and Monitoring Requirements for Type 2 and Type 3 Stormwater

Type	*NAICS* Code (see Appendix A)	Discharge to:	*pH*		*Turbidity (NTU)*		Oil Sheen	Discharge Flow (*gpm*)
			Min	Max	*Average Monthly*	Maximum Daily		
Stormwater (Type 2 & 3) Type 2 monitoring only applicable during earth moving activities	327320, 327331, 327332, 327390, 327999, ECY002	Surface	One/Month		Two/Month[2]		Daily when runoff occurs	see S12.A.6 and S12.A.7
			6.5	8.5	50	50	No Discharge	----
		Ground	One/Month		----		Daily when runoff occurs	----
			6.5	8.5[4]	----		No Discharge[3]	----
			6.5	8.5	----		No Discharge[3]	----

Notes for Tables 2 and 3 (continued).

3. The discharge of sheen or petroleum products to *waters of the state* is a violation and must be reported as a violation. The presence of a visible sheen on *site* is not a violation if the Permittee corrects the problem in a timely manner, notes the occurrence in their Discharge Monitoring Report (DMR), and explains in the DMR the cause and describes the solution. (Also see conditions S4.F.4, S5.C, S9.C and S10.E.)
4. Permittees that have groundwater discharges associated with code ECY002 that exceed 8.5 must comply with the pollution prevention schedule in Appendix C.

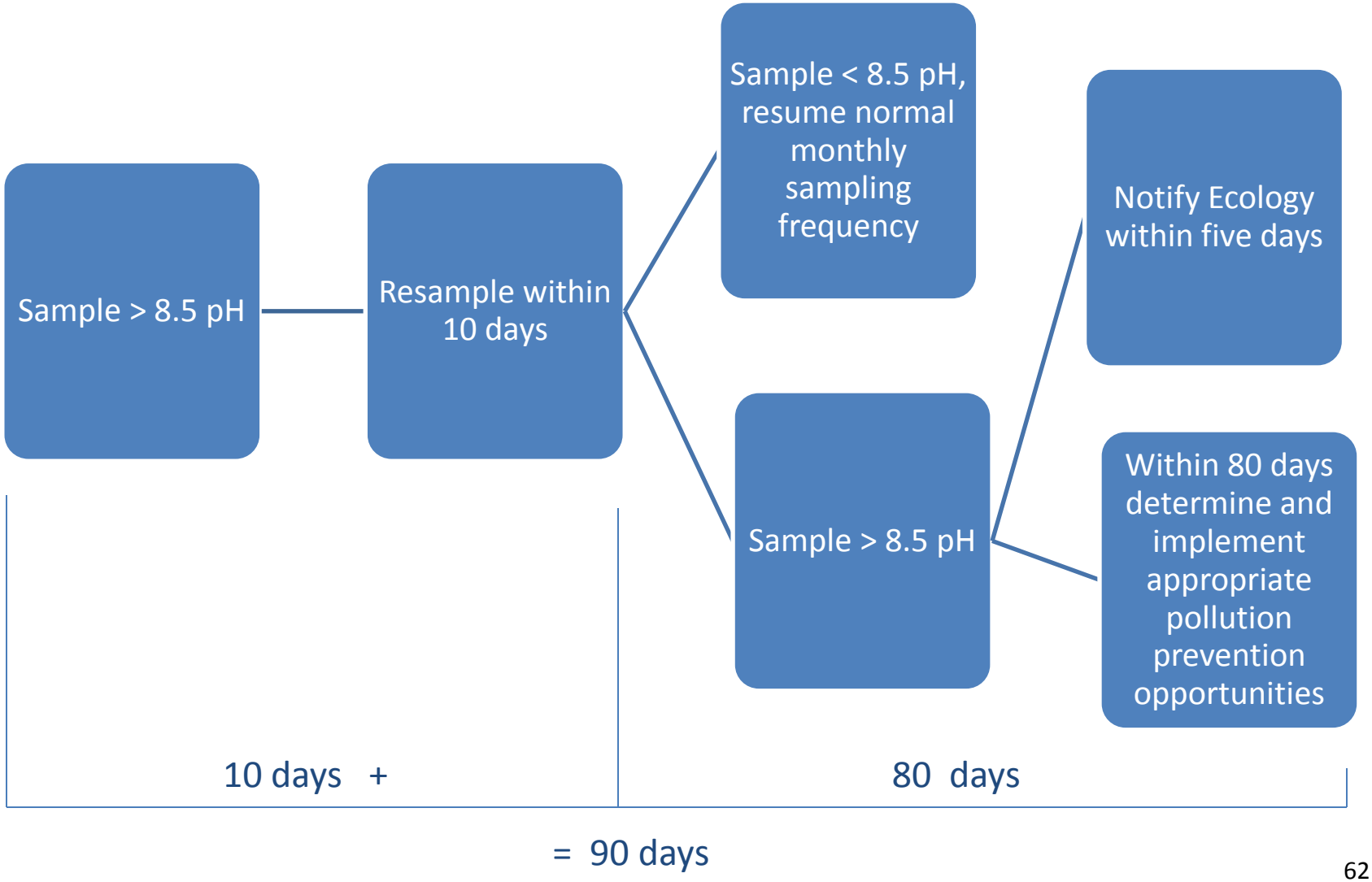
Preliminary Draft Permit Language

- Concrete Recycling Definition
- Code Classification
- Pollution Prevention Schedule
- New BMPs

Pollution Prevention Schedule

- Added a new pollution prevention schedule in Appendix C
- Similar to the one in the 2005 – 2010 permit for Total Dissolved Solids (TDS)
- Requirements for facilities (ECY002) that exceed a pH of 8.5 in any discharge to ground

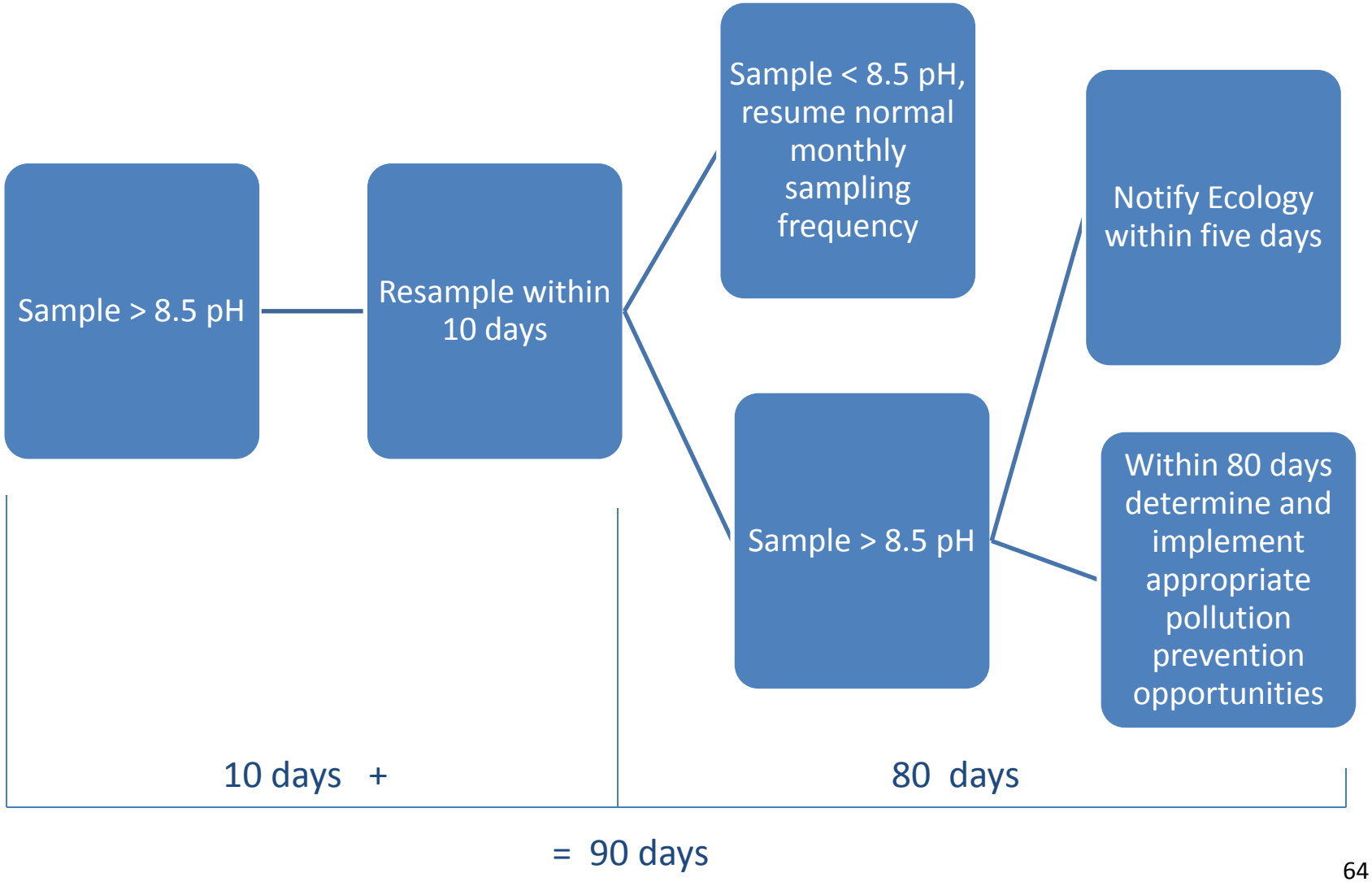
Pollution Prevention Schedule for Concrete Recycling



Pollution Prevention Opportunities

- Grade stockpiles and collect and treat the water from stockpiles of fines and piles < 5/8" less
- Sweep to collect fines
- Limit size of piles (remove material, sell material, or limit adding materials)
- Implement other BMPs

Pollution Prevention Schedule for Concrete Recycling



Pollution Prevention Schedule for Concrete Recycling

If the resampling within 90 days exceeds 8.5, implement **one** of the following within 180 days:

1. Submit to Ecology documentation that the hydrogeology of the site prevents exceedance of the groundwater quality standards

2. Implement a program with an Ecology approved schedule to provide treatment for the pH prior to discharge to ground

3. Conduct an Ecology-approved groundwater impact study

- Per WAC 173-200-080
- Per chapters 4-6 in the *Implementation Guidance for the Groundwater Quality Standards* (Ecology Publication 96-02)
- Submit results to Ecology 30 days after completion of the study

4. Cease discharges to ground related to the recycled concrete

Pollution Prevention Schedule for Concrete Recycling

- 1. Submit to Ecology for review and approval documentation that the hydrogeology of the site prevents exceedance of the groundwater quality standards
  - Thick till
  - Hard rock
  - Compacted soils
  - A hydraulic restrictive layer

Pollution Prevention Schedule for Concrete Recycling

- 2. Implement a program with an Ecology approved schedule to provide treatment for the pH prior to discharge to ground
  - Capital Improvement Program
  - Impervious surface
  - Conveyance system
  - CO_2 sparging system

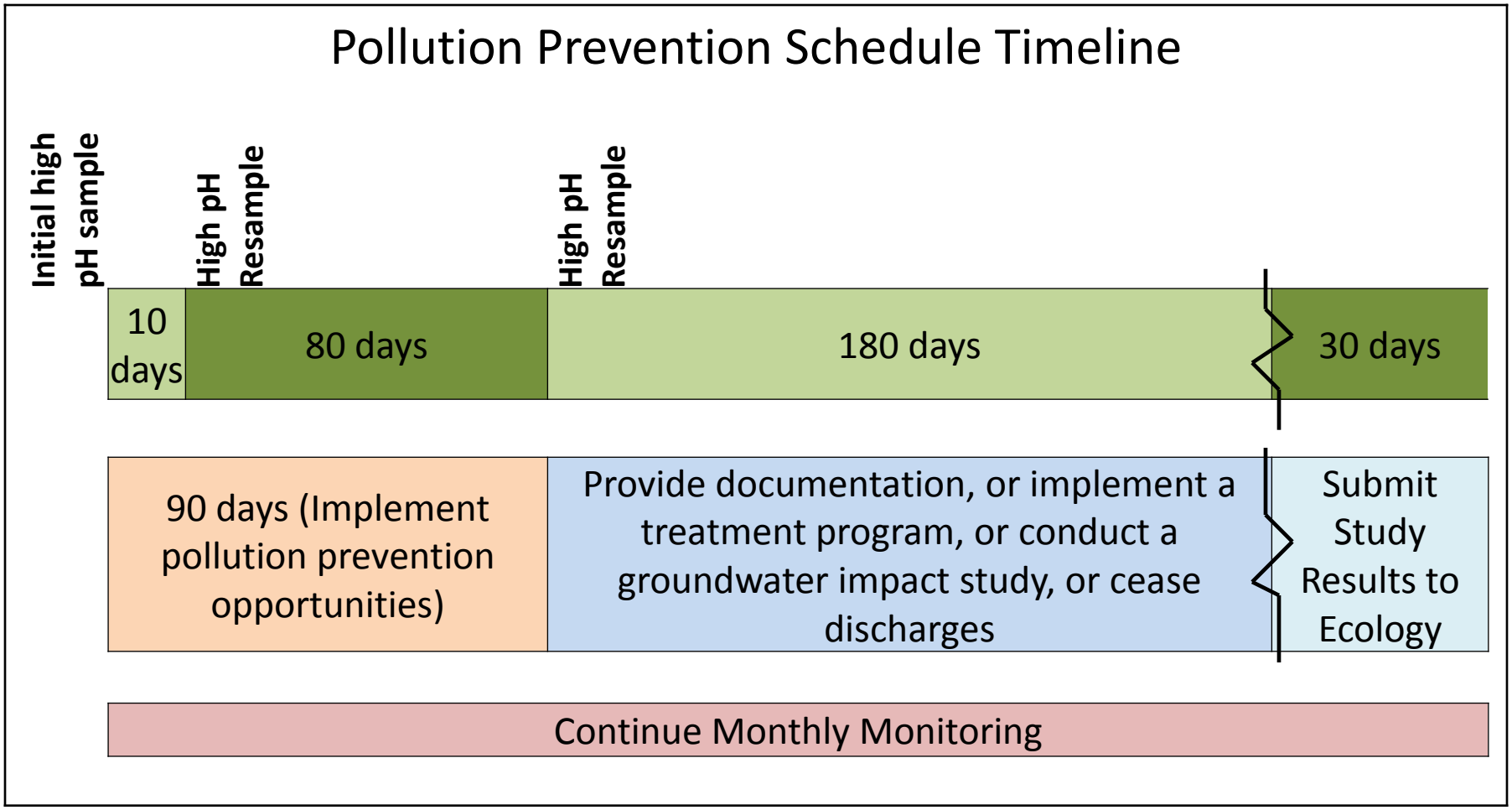
Pollution Prevention Schedule for Concrete Recycling

- 3. Conduct an Ecology-approved groundwater impact study
  - Includes geotechnical and monitoring component
  - Installation of groundwater monitoring wells
  - Chapters 4-6 in the *Implementation Guidance for the Groundwater Quality Standards*
  - Submit results to Ecology 30 days after completion of the study

Pollution Prevention Schedule for Concrete Recycling

- 4. Cease discharges to ground related to the recycled concrete
  - Remove concrete recycling material from the site
  - Install an impervious surface, collect and treat the wastewater

Pollution Prevention Schedule



Benefits of Pollution Prevention Schedule

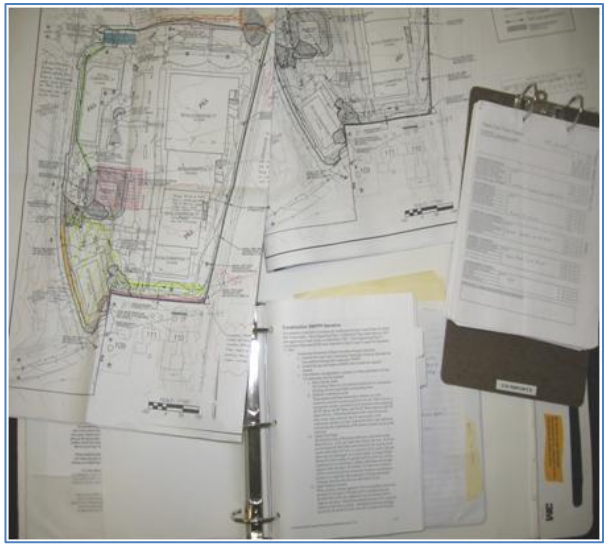
Defined response after 3 exceedances		
Establishes consistency	Takes into account specific site conditions	Provides flexibility

Preliminary Draft Permit Language

- Concrete Recycling Definition
- Code Classification
- Pollution Prevention Schedule
- New BMPs

New SWPPP Section

- Added a new subsection of the SWPPP Section in the Permit (S5 / S8)
- How much time needed to update SWPPPs? (60 days or more by request)



Stormwater Pollution Prevention Plan BMPs

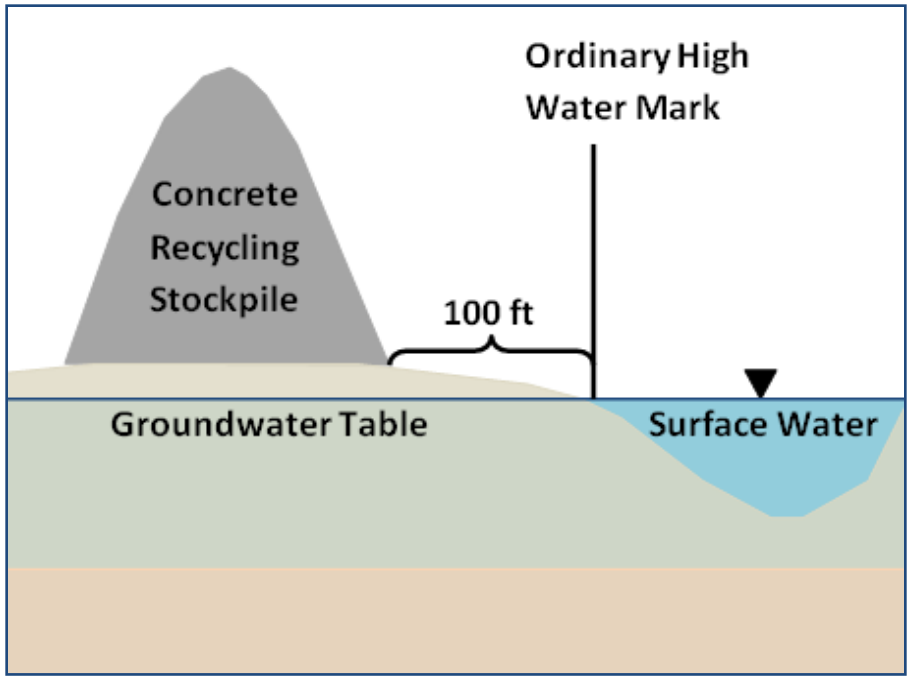
- Permittees may omit *BMPs* if *site* conditions render the *BMP* unnecessary or if the Permittee provides alternative and equally effective *BMP*
  - Hydrogeology of the site
  - Impervious surface
- The Permittee must note the rationale for omission or substitution in the *SWPPP*

Stormwater Pollution Prevention Plan BMPs

- Do not place concrete recycling stockpiles:
  - Within 100 feet or less from the ordinary high water mark of surface water bodies
  - Within 100 feet or less from drinking water and irrigation well(s)
  - Within a Wellhead Protection Area
  - Where there is a discharge to ground and there is not a minimum of 10 feet of separation between the bottom of the recycled concrete stockpile and groundwater

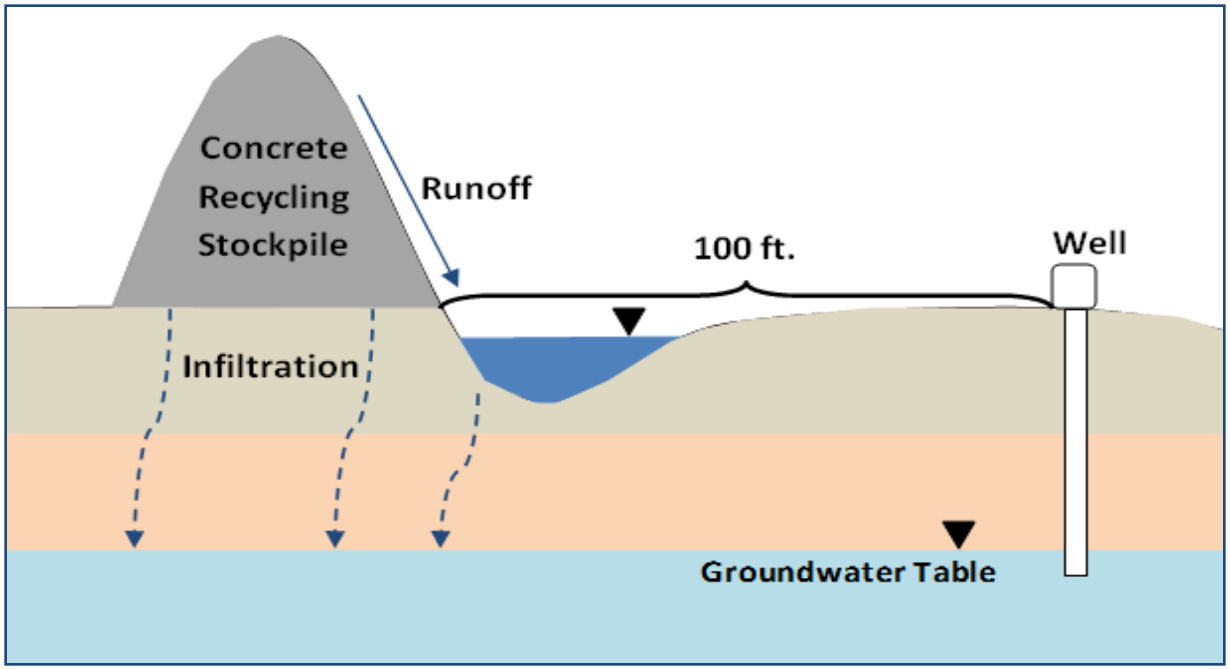
Stormwater Pollution Prevention Plan BMPs

- Place concrete recycling stockpiles at least 100 feet away from the ordinary high water mark of surface water bodies



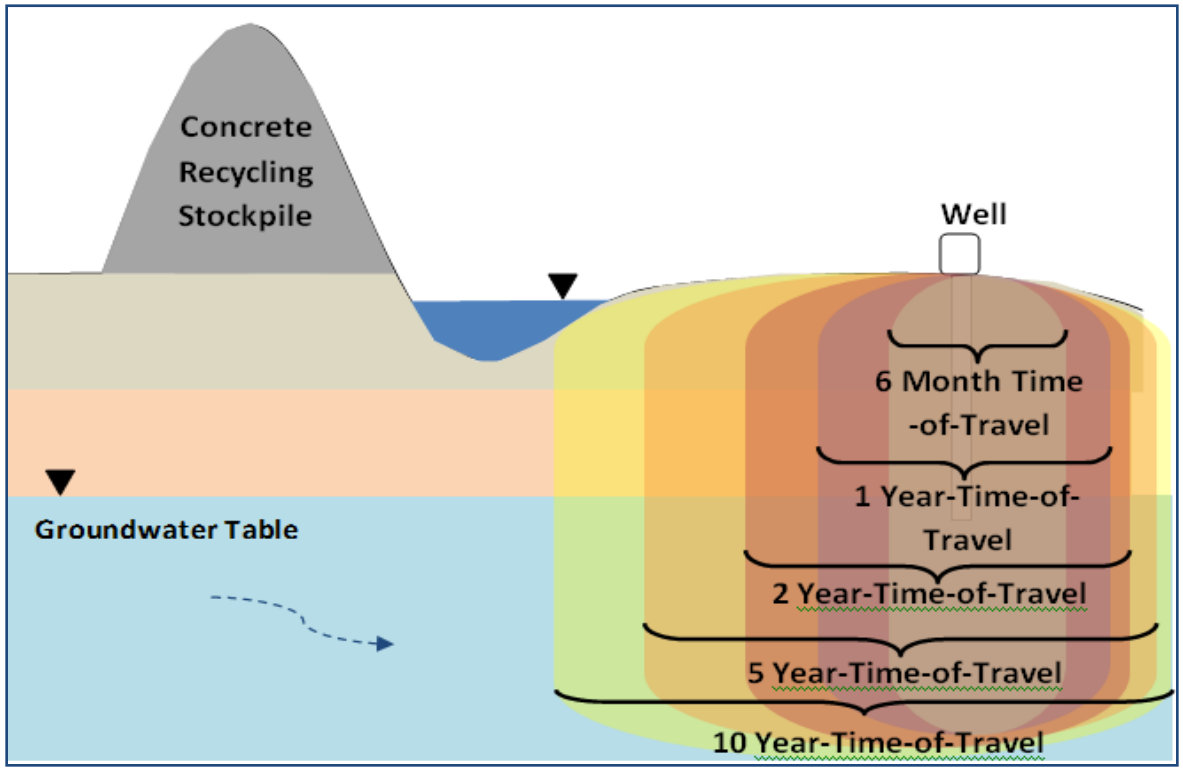
Stormwater Pollution Prevention Plan BMPs

- Place concrete recycling stockpiles at least 100 feet away from drinking water and irrigation well(s)



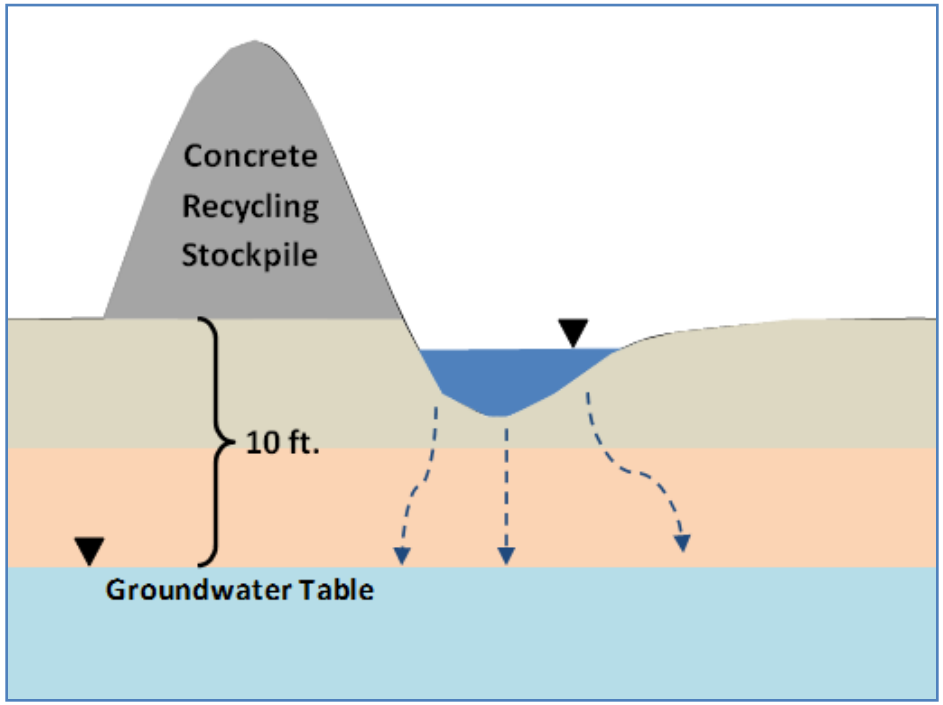
Stormwater Pollution Prevention Plan BMPs

- Place concrete recycling stockpiles outside of Wellhead Protection Areas



Stormwater Pollution Prevention Plan BMPs

If there is a discharge to Ground:



- Place concrete recycling stockpiles:
  - Where there is at least a minimum of 10 feet of separation between the bottom of the recycled concrete stockpile and groundwater

Stormwater Pollution Prevention Plan BMPs

- What if you have stockpiles in these locations?
  - Is the BMP unnecessary?
    - A hydraulic restrictive layer
    - Conduct a groundwater impact study
  - Provide an equally effective BMP?
    - Impervious surface
    - Covering pile
    - Collecting runoff for treatment
  - Relocate your stockpile or stop the discharge?

Stormwater Pollution Prevention Plan BMPs

- Establish materials acceptance procedures to ensure that inbound recycled concrete materials are not a source of:
  - Dangerous waste
  - Lead paint
  - Asbestos
  - Joint sealants which contain Polychlorinated Biphenyls (PCBs)


CLEAN Concrete

Benefits of BMPs

- Protects surface waters
  - Aquatic life
- Protects drinking waters
- Protects irrigation waters
- Limits liability
  - Limits risks associated with dangerous waste
  - Groundwater clean-up
- Provides flexibility

Summary

- Ecology committed to supporting concrete recycling that is done in a manner that is protective of the environment and water quality
- Sand & Gravel facilities have reported pH values between 6.1 - 11.5
- High pH wastewater from concrete recycling can effect water quality and the environment
- The preliminary draft language focuses on when permittees have three pH exceedences for groundwater discharges
- The preliminary draft language:
  - Protects water quality
  - Provides flexibility

Questions and discussion