ANCHORAGE SNOW DISPOSAL SITES: 2013 EVALUATION

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Municipality of Anchorage
Watershed Management Program

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Executive Summary

The Municipality of Anchorage (MOA) and the State of Alaska Department of Transportation and Public Facilities (DOT) are currently authorized to discharge storm water from their combined Municipal Separate Storm Sewer System (MS4) to receiving waters as co-permittees (Permittees) under Alaska Pollutant Discharge Elimination System (APDES) Permit No. AKS-052558. Part IV.A.9 of the Permit requires the Permittees to retrofit or build at least two snow disposal sites according to criteria developed by the MOA Watershed Management Section (WMS) "regarding siting, design and operation and/or using infiltration, evapotranspiration or reuse techniques" and to "..quantitatively assess the effectiveness of their retrofits by measuring changes in chloride and turbidity in melt water..", documenting their evaluation results in a report submitted as part of their annual reporting requirements (Part IV.A.9).

The MOA has completed retrofit or construction of two snow disposal sites using 'V-swale' design concepts and criteria as developed by WMS in 2000 (WMS, 2000b) and adopted by the MOA Public Works Department as standard design criteria for municipal snow disposal sites (Public Works Department, 2007). These sites include the Tudor Snow Disposal Site ('Tudor', constructed in 2004) and the Spruce Street Snow Disposal Site ('Spruce', constructed in 2012). Both sites were operational throughout the winter of 2012-13. WMS inspected both sites in late 2012 and sampled snow melt runoff at these sites throughout the spring and summer of 2013 to evaluate their performance. This report summarizes findings of that investigation and is submitted in compliance with the Permit requirements stated at Part IV.A.9.

The primary purpose of the 2013 investigation is to assess performance, from a water quality treatment perspective, of V-swale snow disposal site design technology. Current V-swale design includes incorporation of aligned and sloping pad geometry (V-swales and lateral drainage channels) that controls for particulates (given proper operation), and designed detention basins that control for chloride (given assumed source snow chloride content and maximum snowfill depths and volumes). As a basis of evaluation, WMS compared water quality treatment performance of flat-pad sites and experimental V-swale installations (as reported in previous studies) in controlling discharge of particulates and chloride (Table 1) to that measured in 2013 at operating V-swale sites. Performance at the two investigated V-swale sites was also evaluated in context with site conformity with V-swale design and operational criteria (Appendix A). This report part briefly summarizes conclusions and recommendations relative to further implementation of V-swale technology at Anchorage based on the results of the 2013 investigations.

Performance Observations			
	Early Melt	**Mid-Melt**	**Disintegration**
No Practices			
Turbidity (NTU)	150-350	350-500	>1,000
Chloride (mg/L)	1,000-10,000	100-500	<100
Shallow Ponding			
Turbidity (NTU)	70-150	150-300	>500
V-Swale			
Turbidity (NTU)	10-50	10-50	<200

Table 1: Snow Disposal Performance at Anchorage

V-swale snow disposal site designs, where implemented and operated according to standard criteria, show significant improvement (one to two orders of magnitude) in treatment and removal of particulates and chloride over all other flat pad designs used at Anchorage. Investigation of two existing sites using V-swale technology at Anchorage in 2013 clearly demonstrates this conclusion, despite observed limitations in performance at both the evaluated sites.

Investigation results varied significantly between the two sites. The Tudor site performed poorly in all respects, the result of design flaws but prominently the result of poor operation practices for these types of designs. The Spruce site performed very well in all respects but 2013 results may have been influenced by low chloride loading during that year. Results for the Spruce site also reflected apparent flaws in detention pond design and construction.

Meltwater from the Tudor site currently releases to an adjacent receiving water through shallow ground water discharge and do not present a significant impact from particulates to that receiving water (despite very poor treatment performance at this site in 2013). Minor chloride impacts are apparent though, and can be improved without any structural changes to the site simply by adherence to V-swale operational practices. Tudor will require retrofit before it can adequately perform as a V-swale site for treatment of particulates but its priority for retrofit is low due to its mean lack of surface discharge. Immediate recommendations for retrofit and operations at this site include:

- Implementation and rigorous supervision of standard V-swale operational standards.
- Complete (prioritized) retrofit using revised V-swale design standards

The Spruce site performs very well as a V-swale facility and was operated exceptionally well in 2013. However, pond drain and liner design may result in poor performance during mean year operations, particularly considering that this site discharges directly to high-value wetlands. Some reduction in mean year performance at this site over that observed in 2013 is anticipated as a result of three conditions observed at this site in 2013. The first includes the detention pond drain placed too high relative to the pond bottom so that the dry volume required for chloride treatment in a mean year may not be present if ice forms in the bottom of the pond as it did in the winter of 2012-13. The second potential problem with this site lies with design of the pond liner. The pond liner, though having a very low intrinsic hydraulic conductivity, may also allow significant fugitive infiltration over the early seasonal snowmelt, increasing pulse chloride loading to receiving waters (adjacent wetlands). The last, and more minor, condition that needs addressing to ensure future performance at this site, includes stabilization of the rock distributary weir currently serving as the site surface outfall to wetlands east of the site. Such stabilization should include placement of a fixed elevation serrated weir along the existing rock weir with rock armor placed on the outside sufficient to tie the structure to the natural wetland surface. Immediate recommendations for retrofit and operations at this site include:

- Implementation and rigorous supervision of standard V-swale operational standards.
- Re-installation of site's detention pond drain to allow complete seasonal draining of the pond.
- Installation of a fixed elevation distributary weir along the full length of the existing weir with armor placed to tie the weir into adjacent natural wetlands.
- Monitoring and re-assessment of pond liner infiltration and early chloride mobilization to high value wetlands west of the site. Should re-assessment demonstrate a potential for significant impact, the liner structure should be modified through design and installation of additional liner, liner subdrain, or similar device to prevent or collect fugitive early meltwater infiltration.

In general, the 2013 investigation confirms the utility of V-swales when properly designed and operated, and their continued design and use at Anchorage is highly recommended. However results also re-emphasize the synergy between design and operation that was expressed in original design concept development documents. For even the best-designed V-swale site, poor operation may actually increase pollutant release over that of a flat-pad design, indicating a need for careful operational oversight if these facilities are to remain controls, and not sources, of site pollutants. With this in mind, sequential placement of snow from bottom of a V-swale to the top, compact placement of snow at uniform depths and across the full width of individual V-swales, rigorous attention to the setback of any snowfill from lateral and end channels, and stacking of snowfill no higher than the specified threshold are basic operational procedures that must be followed for successful performance. Finally, 2013 observations provide insight into future design modifications that can improve V-swale performance as well identify specific modifications that will improve the existing evaluated sites. General recommendations for V-swale sites include:

- Apply V-swale technology as described in current MOA Public Works Department design criteria as the standard practice for design and retrofit of all municipal snow disposal sites.
- Incorporate V-swale design modifications as described in this document including use of drain rock as channel armor and armor rock vertical placement, overlap of detention pond and snowfill, dry volume pond sizing, and pond liner and weir design.
- Implement and rigorously supervise standard V-swale operational practices.

Part 1 - Purpose

The Municipality of Anchorage (MOA) and the State of Alaska Department of Transportation and Public Facilities (DOT) are currently authorized to discharge storm water from their combined Municipal Separate Storm Sewer System (MS4) to receiving waters as co-permittees (Permittees) as authorized and conditioned by Alaska Pollutant Discharge Elimination System (APDES) Permit No. AKS-052558. Part IV.A.9 of the Permit requires the Permittees to retrofit at least two snow disposal sites according to criteria developed by the MOA Watershed Management Section (WMS) "regarding siting, design and operation and/or using infiltration, evapotranspiration or reuse techniques" and must "..quantitatively assess the effectiveness of their retrofits by measuring changes in chloride and turbidity in melt water..", documenting their evaluation results in a report submitted as part of their annual reporting requirements (Part IV.A.9).

Figure 1: Spruce Street Snow Disposal Site

The MOA has completed retrofit or construction at two Permittee snow disposal sites using 'V-swale' design concepts and criteria as developed by WMS in 2000 (WMS, 2000b). The MOA retrofitted the existing Tudor Snow Disposal Site with 'V-swale' design modifications (Tudor) in 2004 and began operations at the site that winter. In 2012 MOA constructed a second, new, facility at the Spruce Street Snow Disposal Site (Spruce) with operations beginning at that site that same winter. Both sites were operational throughout the winter of 2012-13. WMS inspected both sites in late 2012 and sampled snow melt runoff at both sites throughout the spring and summer of 2013 to evaluate their performance. This report summarizes findings of that investigation and is submitted in compliance with the Permit requirements stated at Part IV.A.9.

The report includes an executive summary, the main body of the report, cited references, and appendices. The main body of the report includes four main parts, including this statement of purpose. The second part briefly describes previous MOA investigations, including those of the performance of previous municipal snow disposal facilities, and the history of the development of the V-swale design concept used in both of the evaluated snow disposal sites. The third part summarizes results of sampling and observations made by WMS in 2013 of the performance of the two V-swale facilities. The last part provides discussion of inferences drawn from the 2013 observations, focused on what works and what doesn't and including a summary of recommendations for adjustments to design and operations of V-swale snow disposal facilities at Anchorage. A list of references cited follow the main body of the report

Finally appendices supporting the main report are attached. Appendices include a summaries of V-swale concepts and basic design criteria, design sheets for V-swale facilities at the Tudor and Spruce sites, site maps for 2013 sampling stations at these two sites, and summaries of sampling results and field logs for 2013 field work. Additional information including relational database and geodatabase digital datasets, equipment and calibration information, laboratory reports and chains-of-custody, and field photographs are also available upon request from WMS. Full scale versions of all graphics and figures included in the main report are included in the appendices as well.

Part 2 –Anchorage Snow Disposal Performance History

During development of the Permittees' first permit term conditions, regulators were concerned about pollutants—particularly chloride—discharged from the Permittees' snow disposal sites. As a result first term conditions included requirements to assess pollutants released from the Permittees' snow disposal facilities. Permittees developed and implemented a long-term assessment program specifically focused on developing an understanding of and quantifying pollutant release during spring melting of snow stored at these sites.

WMS pursued observation and data collection at a number of snow disposal sites from 1997 through 2002. Sampling of melt water included testing for a wide spectrum of pollutants (WMS 1998a, 1999a, 1999b, 2000a). The exhaustive sampling and testing completed during this period suggested that focus on control of two, however, chloride and suspended sediments, would reduce the most significant potential sources of impacts to receiving waters from snow disposal sites. Observations during this period also revealed characteristic and late-winter snowfill and melt processes at Anchorage that might lend themselves to effective passive treatment of both sediment and chloride (Wheaton and Rice, 2003). These processes and findings from WMS' previous studies are briefly summarized below.

Average maximum daily temperatures typically do not rise above freezing at Anchorage. As a result snow hauled and stored at snow disposal sites does not periodically thaw and melt but rather accumulates as an entire seasonal mass still present at spring. Due to space limitations, snow is typically stacked 15 to 30 feet high. As a result, in early spring internal temperatures at depth in the snow generally reflect average daily winter temperatures.

At Anchorage, snowfill melting takes place in clearly recognizable stages with predictable pollutant characteristics (Figure 2). As the snow begins to melt in the spring, it melts from the surface. The surface meltwater infiltrates the deep snowfill, leaving dirt in the original hauled snow behind as a surface layer. Early in the melt season the surface meltwater cools as it infiltrates to the bottom of the cold fill. Until deeper, colder, snowfill temperatures equilibrate at or near 32^{o} F, the initial infiltrating meltwater freezes at the bottom of the fill forming a 'basal' ice layer. After temperature equilibration and freezing is no longer taking place, the infiltrating meltwater flows across the surface of the basal ice layer—early on as saturated flow and later along melted conduits—ultimately discharging from the perimeter of the fill.

During melting, infiltration, and early meltwater conduit flow, sediments contained in the original snowfill are not mobilized and tend to collect on the surface of the deflating snow mass. Later, as conduit flow through the snowfill becomes more dominant, the basal ice layer protects pad soils from erosion. Only late in the season, as the basal ice degenerates and is removed and sediment in the original hauled snow is dropped to the pad surface do the snowfill sediments become subject to erosion. Thus in a V-swale facility, sediment release is small early in the season and has the potential to increase only late in the season.

However the converse is the case for chloride: chloride is at high concentrations in early meltwaters (well above the average chloride concentration of the source snow) and rapidly drops to concentrations well below that of the source snow as the season progresses. Chloride is readily eluted (leached) during early snowmelt infiltration, and, though average chloride concentrations in initial Anchorage snowfill can be relatively modest (50 to 150 mg/l), leaching can result in very high chloride concentrations (as high as 10,000 mg/l) in early snowmelt discharges (Figure 2). For a given initial chloride concentration, the higher the snow is stacked, the larger the initial leaching concentrations (see Novotny 1999 for an excellent description of this process).

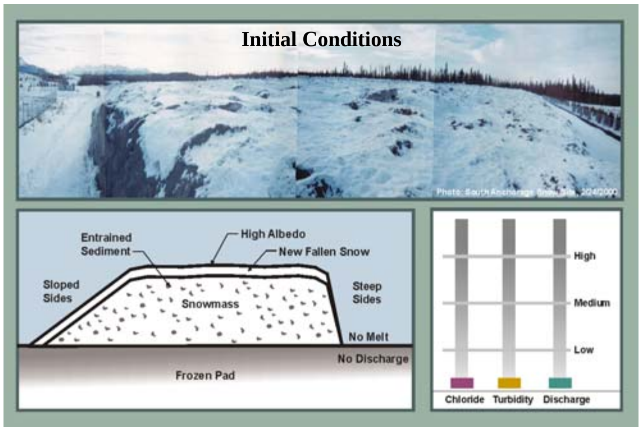
During early WMS investigations, standard Anchorage practice was to place hauled snow on relatively flat pads with little consideration given to the water quality implications. As a result stacks were often high with sloping sides (from pushing snow with bulldozers to stack it). Chloride concentrations of early meltwater releases were related directly to the amount of salt applied to the streets and the height of the stack. The sloping snowfill sides also often resulted in elevated turbidity from meltwater discharging along the lower sides of the stack and saturating and mobilizing the sediments collecting on the surface. Uneven pad surfaces led to unpredictable locations of meltwater discharge from the snowfill and subjected the unarmored pad to localized erosion and scour.

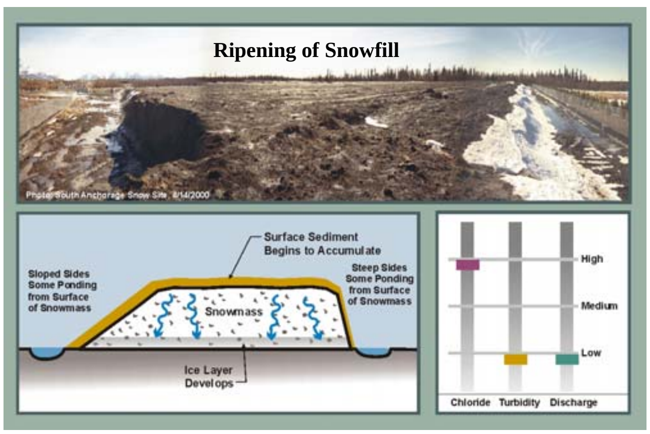
Observation of these processes led to WMS' development of the V-swale concept (Figure 2 and Appendix A). The V-swale design critically combines construction of a specific pad geometry and a dry detention basin with operational practices. Pad geometry incorporates one or more shallow V-shaped swales aligned sloping down to the north. The Vs maintain flow of meltwater across the basal ice layer and along a swale's armored axis, directing flows to a single discharge point at the swale's lower end. The north-sloping alignment encourages a melting sequence that progresses from south to north, reducing late snowmelt flow across snowfill dirt collapsing onto the pad surface. The dry pond is intended to collect and hold a calculated volume of the early high-chloride concentration meltwater for dilution with later low-chloride concentration meltwater. The pond's required dry detention capacity is estimated based on leaching rates under Anchorage's mean spring temperatures, the average chloride content of the site's source snow, an assumed maximum height and volume of snowfill for the site, and chloride sensitivity of a site's receiving waters. Finally, because of the design's sloping surfaces, operational practices are critical to successful performance of a V-swale facility. These primarily include uniform placement of snow across the full width of the Vs and below a designed threshold snowfill height (related to required dry pond capacity for adequate chloride treatment). Uniform and steepsided snowfill across the full width of Vs is necessary to prevent early-season collapse of interior portions of V-swales and exposure of the released snowfill sediment to the meltwater flows from remaining upslope snow masses.

Early experiments with this design showed great promise, in particular in reducing release of sediments with meltwater flows (Figure 2). As a passive treatment control, it appeared to be able to provide very effective treatment at a relatively low cost (initial capital costs and continuing operational care). However, it was also very clear to design developers that a combination of design and careful operations are critical to the success of this design.

The Permittees reported this work to EPA and identified the V-swale concept as a potential solution (along with reduced salt application through heated sand sheds) to the problems of high turbidity and chloride release observed at Anchorage snow disposal facilities. To support implementation of the V-swale concept in future snow disposal site retrofit and construction, WMS developed design criteria and operational guidance (Figure 3) which was later adopted by and incorporated into the Municipality's Public Works Design Criteria Manual. To date, two facilities the Tudor Snow Disposal Site (2004) and the Spruce Street Snow Disposal Site (2012) have been constructed using this concept (Appendix B). These two sites are the subject of WMS' 2013 investigations.

Initial Snow Conditions		
Constituent	**Range**	**Median**
Water Equivalent	60%-72%	60%
Chloride	53-140 mg/L	115 mg/L
Total Sediment	0.6-14.6 kg/cu.m	3.25 kg/cu.m





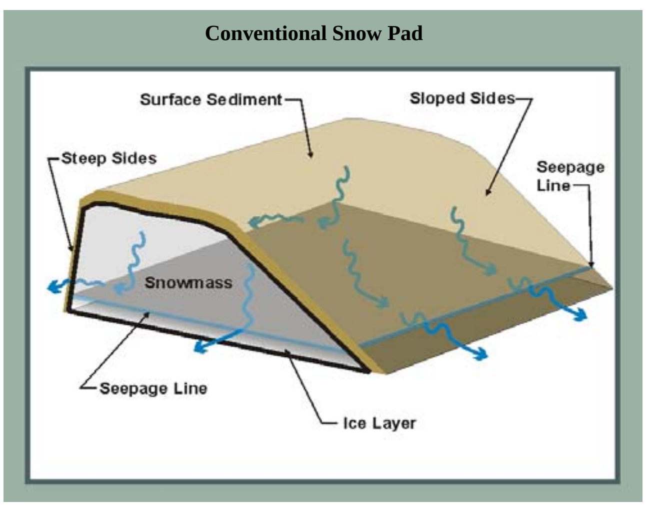
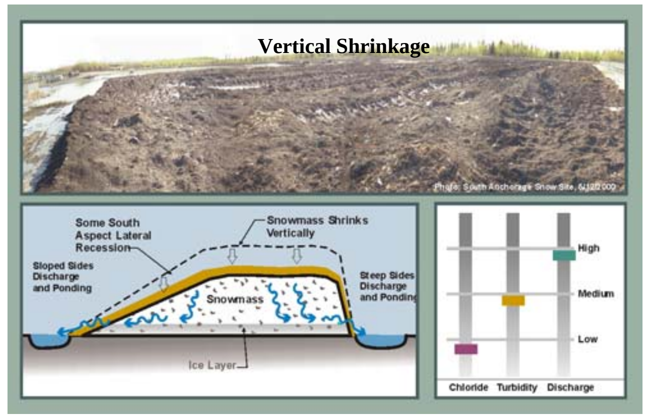
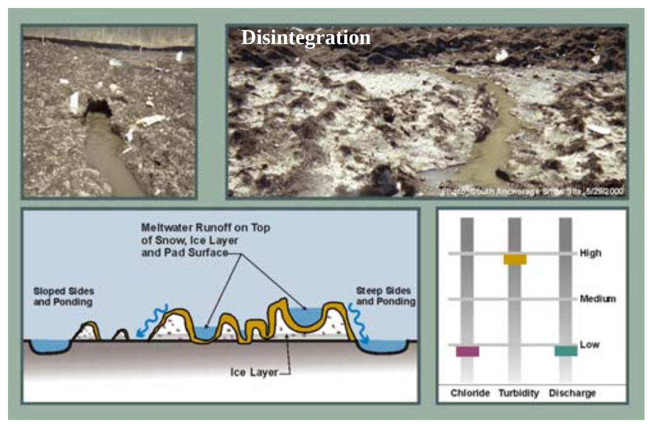
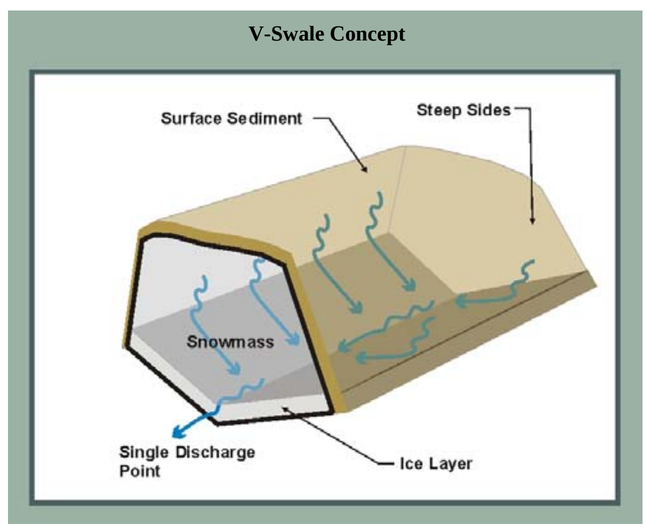


Figure 2: V-Swale Concept
Snow Site Processes and V-Swale Performance

Performance Observations			
	Early Melt	**Mid-Melt**	**Disintegration**
No Practices			
Turbidity (NTU)	150-350	350-500	>1,000
Chloride (mg/L)	1,000-10,000	100-500	<100
Shallow Ponding			
Turbidity (NTU)	70-150	150-300	>500
V-Swale			
Turbidity (NTU)	10-50	10-50	<200







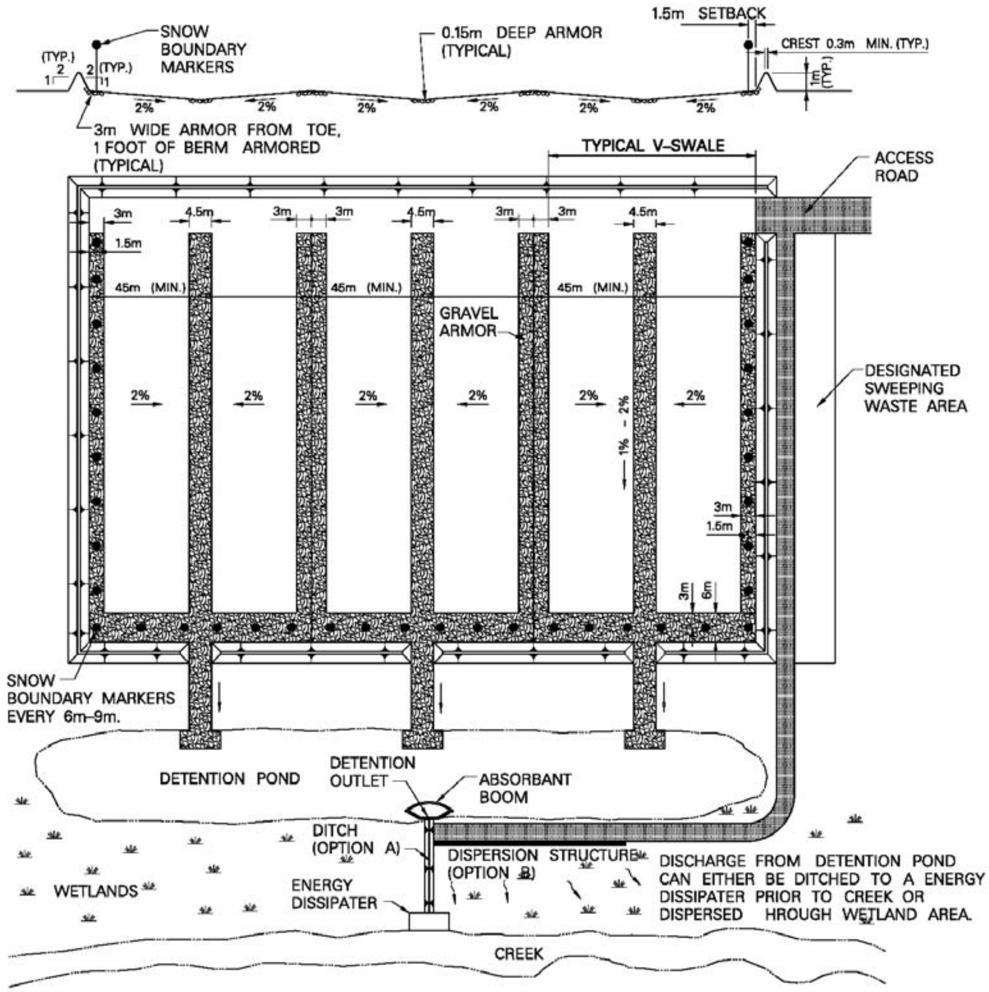
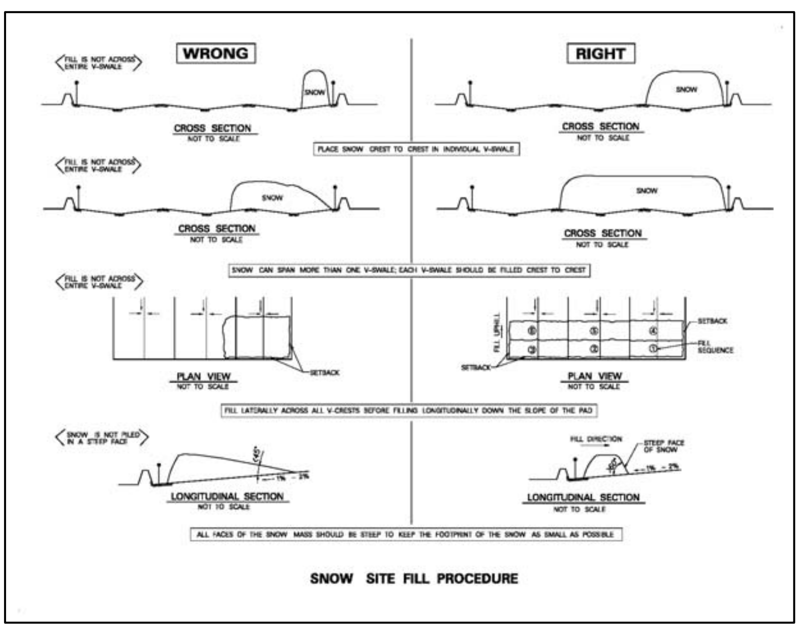


Figure 3: V-swale design schematic (above) and operational guidance (below)



Part 3 – 2013 Field Investigation

WMS completed field inspections and sampling at both the Tudor and Spruce sites in late fall 2012 (prior to snowfall and filling operations) and during the spring and summer of 2013 (after winter snow haul operations had ended). Field work was designed to evaluate performance of the V-swale installations at these two sites in reducing release of chloride and sediment. Assessment of impacts of snowmelt releases to receiving waters at these two sites was performed as a secondary objective and in compliance with other permit requirements (MOA, 2010; USEPA, 2009).

For each of the sites, locations for field measurement and sample collection were established at critical process points relative to V-swale treatment. At Tudor, which includes a detention basin that is not sized to the site chloride loading, we selected the outlet weir at the base of one of the two primary V-swale elements as the primary sampling location (Tdr_WR1). Additional sampling locations included a station at the outlet weir of the second major V-swale (TDR_WR3), a station in the detention pond itself near its outlet (Tdr_Dpnd1), a station at the ditched outfall of the site (Tdr_OF), and a station in the receiving stream at a point just below the site outfall ditch (Tdr_Stream). An additional sample was also collected of meltwater impounded upslope of the snowfill, i.e., of 'backwater' meltwater (Tdr_Mpond).

Figure 4: Tudor Snow Disposal Site 2013 sampling stations

At Spruce, a similar approach was taken. However sampling locations at this site took into consideration a design that placed the downhill end of the snow into the designed detention basin itself (i.e. as the detention pond filled, water from the pond rose onto the base of the lower end of the snowfill thus flooding the lower end of the site's single V-swale axis). Therefore, the primary performance sampling location for this site was at the outlet from the distributary weir (Spr_WR2), i.e., at the point of discharge from the detention pond. This location is also the defined 'outfall' point for the site, with receiving waters (wetlands) directly abutting the base of the rock distributary weir. Because treatment by the detention basin was in effect sampled at this location, samples were also periodically collected from the detention basin waters itself (Spr_WR1 near the pond weir, and Spr_Dpnd1 at the west shoreline of the pond). Additional samples of impounded 'backwater' meltwater (Spr_Mpnd3) and surface meltwater flow (Spr_Mpnd1) were also collected to help characterize performance. At the Spruce site additional field measurements were also made of the wetland waters themselves both where they were most likely to be impacted by site discharges (Spr_Wet0 through Spr_Wet2) and at locations outside the probable zone of impact at likely locations of background conditions (Spr_Wet3 and Spr_Wet4). These measurements were made to test design assumptions that V-swale treatment along with rapid dilution with a large seasonal influx of snowmelt to the wetlands would mitigate impacts to the these receiving waters.

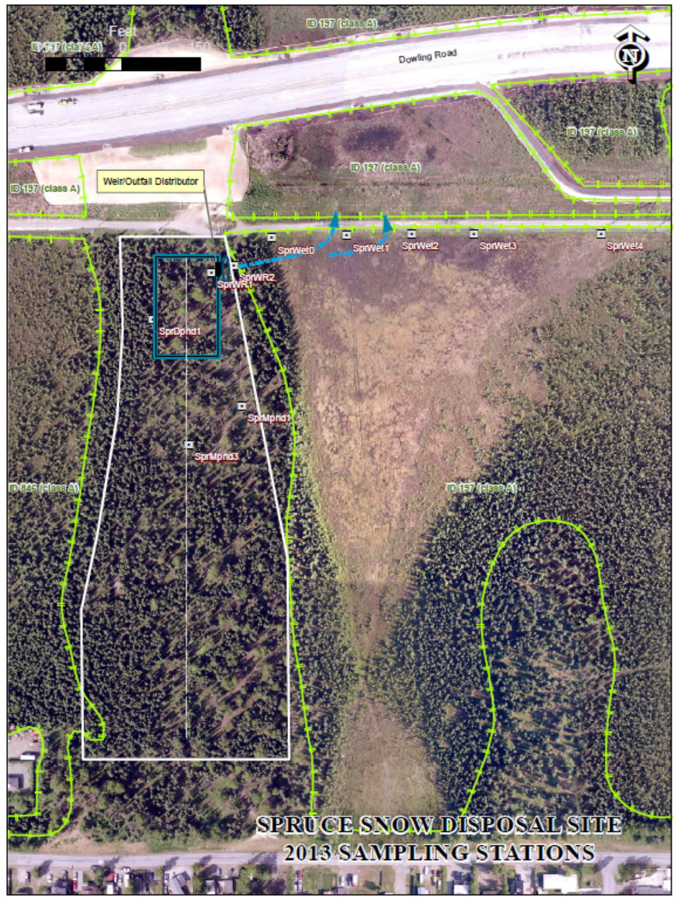


Figure 5: Spruce Snow Disposal Site 2013 sampling

In 2013 samples were taken and observations were made at both sites on a weekly or more frequent basis from May 10 through July 19. Sampling began after meltwater was first released from the melting snowfill at both sites (May 10). At Tudor meltwater was already discharging from all three main V-swale axes, flowing across Tdr_WR1 and WR3 and entering the site's detention pond. Minor surface flow (<5 gallons per minute, gpm) was observed near the Tudor outfall (Tdr_OF) but these small surface flows infiltrated prior to reaching the site's receiving water, a small stream to the west of the site. After May 10th no surface flows were again observed entering the stream from the site. From previous work at this site, for mean snowfall years all site snowmelt infiltrates and enters the stream to the west as shallow ground water flows, likely along pipe and other infrastructure bedding present along the south side of the Tudor Road ROW.

At Spruce, by May 10th meltwater had collected in the detention basin, but no flows were discharging across the basin's weir. At the time, surface flows were observed at the distributary weir (at Spr_WR2), though, discharging directly to the wetlands to the east of the site. In fact, throughout the investigation, no flows were ever discharged across the detention pond weir. All surface flows from the site were observed to originate as flows discharging vertically and energetically from around the outside toe of the basin weir. The source of the surface flows observed at the distributary weir undoubtedly originated from basin waters escaping as seepage and underflow around the weir. The pond is located near a high point in the local original topography and synchronous samples collected from basin pond water at Spr_WR1 and flows at the distributary weir at Spr_WR2 showed correlative water quality characteristics throughout the investigation. Basin weir design did not include robust cutoff wall or seepage prevention measures which would further suggest increased seepage should be expected at this point on the pond. Finally, estimated flow rates at the distributary weir also approximated flows that might be anticipated for a snowfill of the size present at Spruce in spring 2013, based on previous MOA site studies.

However, though we conclude a substantial fraction of Spruce meltwater in fact did exit the site as surface discharge across the distributary weir in 2013, based on original site grade and pond design, there is some probability that some fraction of site meltwaters were also discharged to the west. The site detention basin is constructed on unsaturated fill placed over an original ground surface that over some portion of the pond footprint sloped to the west. The original ground sediments are generally comprised of dense, silty glacial tills of relatively low permeability. Vertical infiltration from the pond into the fill has a probability of being preferentially directed along the westward slope of the original ground. The detention basin is lined with a low-permeability geosynthetic clay liner (GCL) that significantly impedes vertical flow to underlying sediments. Periodic inspection around the perimeter of the site during our investigation did not reveal any visible seepages that could be attributed to fugitive surbsurface flows from the detention pond. However the site was grubbed before construction and fill placed along the western perimeter of the site below the depth of the thin surface duff and peat present there, likely providing relatively good hydraulic connection between the fill and surface organics west of the site, particularly for very small flows. Finally, a sample collected of surface waters from the western wetlands late in the melt season at a point (Spr_Wet5) approximately along a flow line that might carry seepage flows originating from the detention pond showed an anomalous chloride concentration. Therefore, given a subsurface flow route as the sole source of observed discharge from Spruce in 2013, additional assessment of pond seepage rates should be made.

Field work at both Tudor and Spruce consisted of field measurements for temperature, electrical conductivity, pH, nephelometric turbidity units (NTUs), and visual estimates of flow at multiple sampling stations at each site. In addition, samples paired to field measurements were collected for chloride and suspended sediment concentration (SSC, a method testing the entire collected sample) and transmitted to a certified laboratory for testing. Lab results were used to estimate correlation between the field surrogate measures (conductivity and nephelometry) and laboratory measured pollutant concentrations (Appendix D). Linear correlation of lab chloride values with paired field conductivity measurements were very good at both sites (r^2 greater than 0.99 for all paired datasets). Correlation between SSC lab values and field NTU measurements were also very good for Tudor (r^2>0.99) and acceptable for Spruce (r^2>0.84). The lower correlation at the Spruce site is likely because of the low range in measured concentrations at that site (2 to 13 mg/l) compared to that at Tudor (7 to 240 mg/l).

Results for sampling at both sites in 2013 are summarized below for the primary analytes pH, chloride and suspended sediment. Chloride concentrations reported here are based on field conductivity measurements converted to an estimated chloride concentration using correlation results. Field-measured NTU values have not been converted, as insufficient lab data was collected to establish correlations between all bodies of water sampled. Nevertheless, the correlation analyses that we did perform demonstrate a reasonably predictable relationship between NTU field measurements and laboratory SSC values. We believe these can be used to convert NTU measurements to a usefully representative suspended sediment concentration where the reader desires. For this discussion we refer only to NTUs as they form the bulk of the measurements made. Finally, we did not measure turbidity either in the field or in the laboratory for samples assessed at stations in the receiving wetlands at Spruce. These waters typically are highly colored and turbid from high concentrations of organic particulates and insect larvae (mostly mosquitoes during 2013 investigations) and from color from tannins and their derivatives (Figure 6).

Figure 6: Tannic water at Spruce east wetlands

Suspended Sediments Treatment

Efficacy at treating suspended sediment released in meltwater was identified as a primary strength of the V-swale snow site design technology in its early conceptual development. Early studies suggested a properly designed and operated site at Anchorage should reduce turbidity in meltwater measured at the exit from V-swales to about 50 NTUs for most of the season with turbidity perhaps rising as high as 200 NTUs as snowfill collapses and basal ice erodes at the end of the melt season. A time series of NTU measurements made at sampling stations at each of the sites in 2013 are displayed in Figure 7.

Both sites performed reasonably well in the early melt season, though Spruce performed at a uniformly better level than Tudor, with turbidity of discharges to the receiving wetlands at this site narrowly ranging between about 7 and 13 NTUs. Over the season, turbidity of discharge waters from the Spruce site did not rise much above about 20 NTU and typically ranged below 10 NTU. Late in the season turbidity in the detention pond rose to near 20 NTU due to dropping water level in the pond and a resultant increase in vulnerability of bottom sediments to wind stirring. Good performance in sediment treatment measured in 2013 may be in part due to lower dirt content in the snow hauled to this site (snow is predominantly from residential sources) and a relatively low snow loading (the site in 2013 was only filled to about 20% of capacity). However the Tudor site had a similar low snow loading and performed quite poorly in chloride treatment.

Despite these confounding factors, we believe that the performance measured at the Spruce site in 2013 primarily reflects several factors. First is implementation of improvements at the Spruce site in the V-swale design concept since Tudor retrofit, including designed snow placement inside the high water limits of the pond (decreasing sediment erosion and mobilization along site drainage channels during late season snowfill collapse) and use of subdrains and washed rock as armor along the perimeter drainage channels of the V-swales (effectively controlling sediment mobilization along these features). It was also clear to us that this site was operated at a high level of attention to the operations standards laid out in the original concept documents. Most important of these was uniform placement of snow across the full width of the single V-swale used at this site and prevention of snowfill encroachment into the lateral armored channels at the swale perimeters.

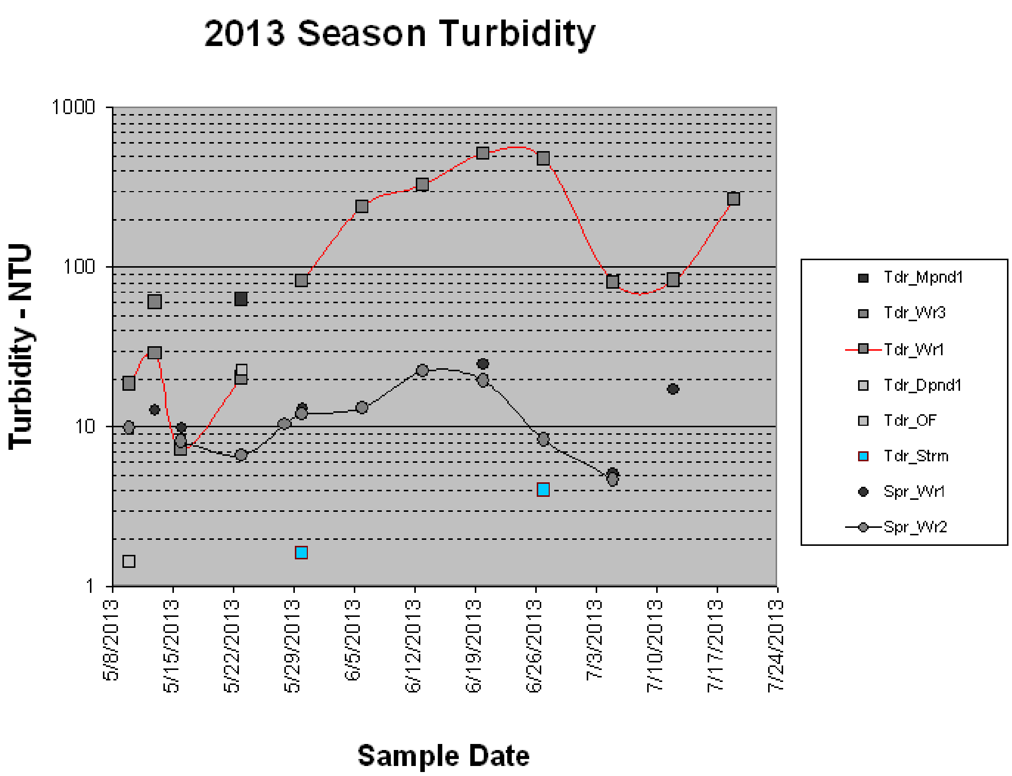


Figure 7: Turbidity in meltwater at 2013 snow sites

Turbidity at Tudor was markedly poorer than that observed at Spruce throughout the 2013 melt season. Turbidity was variable in the early season then rose dramatically, peaking at over 500 NTU by the end of June. By early July the site had improved but experienced another rise in turbidity in mid-July when field observations in 2013 ceased. In fact, turbidity performance at this site overall approximated that of flat-pad snow disposal sites assessed originally by WMS in the late '90's. Fortunately, this site does not discharge surface flows to receiving waters so that the poor turbidity performance does not present an immediate water quality concern.

Certainly, however, the poor turbidity performance measured at this site in 2013 does raise questions about the reasons for it, particularly in light of the excellent performance of the Spruce site. The reasons became clear as the season progressed and include both design and operational flaws. Design flaws include poor channel armor materials and placement, widely asymmetric V-swales, and lack of lateral subdrains. The design for this site specified sandy gravel as armor material be placed along central and lateral drainage channels. If the site was otherwise designed and operated correctly this may not necessarily have represented a serious performance problem. However combined with the highly asymmetric designed widths of the outsides of the two primary V-swales and the serious operational flaws occurring at this site, these materials became subject to large flows that readily eroded them. The armor placed on the outside of the V-swales was elevated above (placed on top of) the pad surface, directing meltwater flow along the outside edge of the gravel 'armor', increasing erosional forces both into the armor gravels as well as along the unarmored surface of the pad itself. Converse to the outside armored channels, during construction armor along the V-swale axial channels were inset significantly below the pad surface. This has led to rapid infilling along the resulting depression with sandy sediments washed into it during the latter stages of seasonal snowmelt. Thus the axial channels, rather than representing an armored surface resistant to erosion, present a regular source of easily mobilized fine sediments, refilled annually during late season waning meltwater flows, and then later eroded as the basal ice collapses the following season, exposing them to higher flows. The site also lacks subdrains placed along the lateral channels which also play a significant role in reducing erosion.

Though design problems created conditions favorable for site underperformance, without doubt operational practices at Tudor played the starring role in the unusually poor performance observed at this site in 2013. As described in original V-swale concept descriptions and in MOA design criteria, successful operation of a V-swale snow disposal site from a water quality treatment perspective requires careful adherence to a few, quite simple, operational practices. These include primarily placement of uniform depths of snowfill across the full width of any one V-swale, starting at the lowest point along the V-swale axis and proceeding upslope. These practices are important because the slopes incorporated into the pad as part of this design type have the potential to actually increase sediment erosion where snowfill is placed partially across a V-swale or at non-uniform depths. Secondly, snow should not be placed so as to obstruct lateral drainage channels. Basal ice develops just as readily under snow placed in lateral channels as it does under any other snowfill. Any basal ice is quite resistant to both physical and thermal erosion and as a result it creates a very effective dam at the pad surface for much of the season. Snow placed in a lateral channel and the resulting basal ice formed beneath it, then, not only quite effectively prevents passage of snowmelt waters along the channel, it can also dam a significant backwater volume. When the basal ice does become fully penetrated later in the season by incipient meltwater conduits, these typically become very rapidly enlarged (a matter of a few hours), abruptly releasing very large flows having destructive erosional effects.

Unfortunately, all the don't dos described above, in fact were done in 2013 at Tudor. In 2013 snow was placed at the Tudor site at initial shallow depths (about 15 feet) along the lower ends of the V-swales. Later, about a third of the way up the swales, snowfill was placed at twice that depth or deeper. Deep snowfill was also placed across lateral channels at several locations along the V-swales. Finally, near the end of the winter hauling season, snow was placed in massive 'wings' across the outer channels along the outside perimeter of the site's two main V-swales, combining with the central snow mass to form a crescent of deep snow wrapping around the central, upslope portion of the site (Figure 8). As seasonal melt began, the outer wings of this crescent, underlain now by basal ice, dammed meltwater in a large pond above the main snow mass. The pond, blocked from the lateral channels by the 'wings' of snow placed in the lateral channels, grew sufficiently in size in the early melt season to flow down one of the site's access road. Eventually the basal ice under each of the outer crescents of snow failed, releasing a catastrophic flood of ponded meltwater down the lateral channels over a period of just a few hours. The abrupt release sent a very large flow down the unarmored channels, gouging sediment from the channel bottoms and their containing berms. The bends imposed on these channels by the V-swale asymmetry further increased scour due to directional and momentum changes. In this case the large mass of scoured sediment did not leave the site but the effects were measurable as the large increase in turbidity observed in mid-June.

Figure 8: Snowfill 'wings' blocking lateral channels at Tudor site

The non-uniform snowfill and in-filled, asymmetric V-swales also contributed to the mid-season elevated turbidity and the abrupt increase in turbidity observed at this site in early July. The thin snowfill at the lower end of the V-swales melted out much sooner than the deep mass of snowfill placed near the middle of the pad. When the thinner snow had collapsed onto the pad surface downslope of the remaining thick snowfill, the loose saturated dirt, now released to the pad surface, became subject to erosion by meltwaters from the snowfill remaining upslope (Figure 9). Erosion of the downslope sediments were pronounced and are reflected in the rising turbidity measured at the end of the season at this site. In any event, the poor performance observed at Tudor in 2013 does not so much discredit the utility of the V-swale concept (particularly given its stellar performance at Spruce) as provide a useful reminder of the importance of

Figure 9: Collapse and exposure of downslope sediments to upslope meltwater at Tudor site

understanding and implementing best design concepts along with basic operational rules at V-swale-type facilities.

Chloride Treatment

Treatment of chloride by a V-swale facility is less a result of the unique character of the pad configuration itself as it is of the other elements of good design and operation. Factors in chloride control, as for particulate control, include both design and operational elements. The primary design factor includes establishing adequate dry capacity of the site's detention pond (calculated based on assumptions about source snow—initial chloride concentration—and maximum depth and total volume of site snowfill, see Novotny, 1999, for a detailed discussion of methods). The primary operational factor includes stacking snowfill no higher than some established threshold (based on the designed dry capacity of the detention pond). Failure in either of these can result in dramatic chloride releases from a snow disposal site early in the seasonal snow melt period. Performance at Tudor and Spruce in this regard were assessed by periodic measurements of conductivity as a surrogate for chloride. A time series of measurements at both sites are displayed in Figure 10.

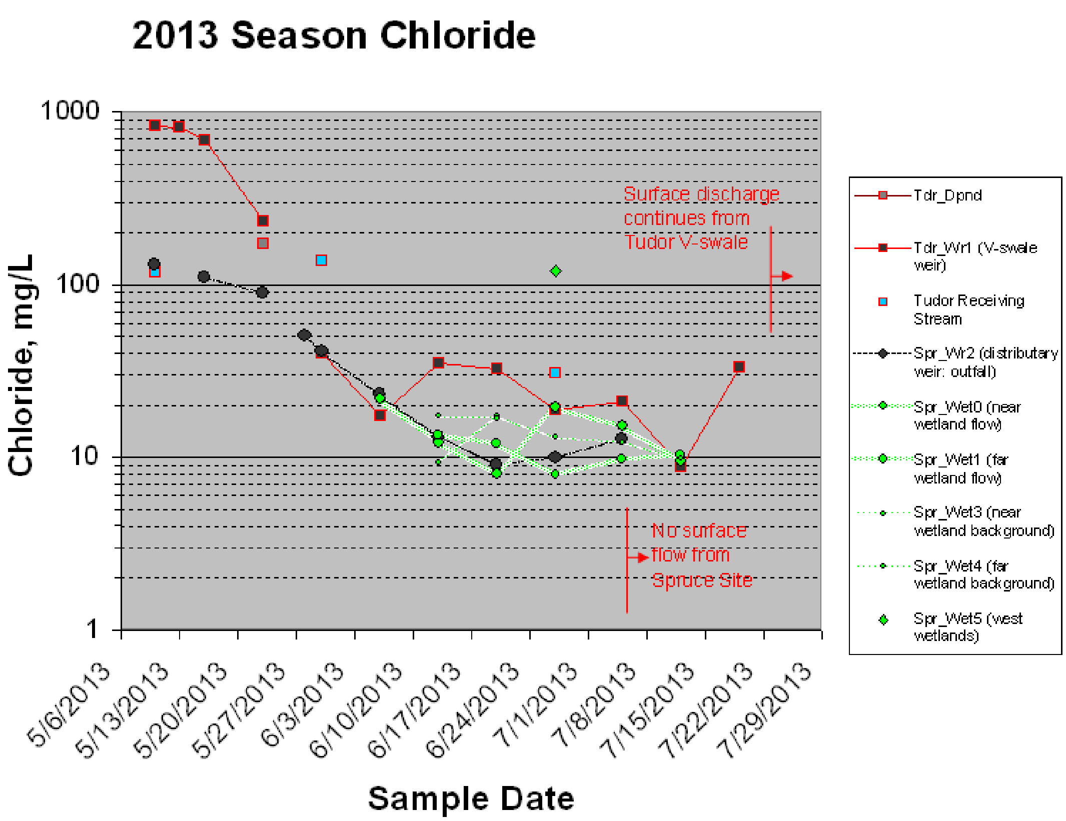


Figure 10: Chloride in meltwater at 2013 snow sites

Inspection of results at Tudor is again instructive. Early peak chloride releases at this site are about an order of magnitude higher than those measured at Spruce and reflect an anticipated peak chloride release typical of flat-pad Anchorage snow disposal sites. Some of this may be due to the high chloride content of the source snow (snow at the Tudor site is hauled primarily from DOT arterial streets where sand applications may contain salt at concentrations of about 1/10th to 1/5th the weight of the sand). Most chloride measurements at this site were also made prior to any pond dilution. However, the Tudor pond was not designed to provide effective dilution of peak snowmelt and limited chloride measurement of the detention pond waters in 2013 suggest that the pond is in fact undersized relative to effective peak chloride dilution. On the other hand, snow volumes at the Tudor site were small relative to a mean year, representing a reduced total potential for development of large peak chloride releases. Considering combined effects of all these factors, the high chloride peak observed in 2013 at this site is quite likely primarily due to high-stacking. About 50% of the total snow mass was high-stacked to a depth of about 35 to 45 feet, significantly increasing the initial mass of chloride leached per unit area of snow present. A decrease in average snowfill depth and more uniform snow placement would certainly have reduced the peak chloride release.

Seasonal peak chloride concentration measured at the Spruce site, at about 130 mg/l, was substantially less than that measured at Tudor. This likely approximates optimum performance given that historically average chloride concentrations in Anchorage hauled snow ranges from about 50 to 150 mg/l. That said, optimum performance is particularly important here, due to this site's direct discharge to a sensitive wetland and its proximity to a Municipal potable water well. This site was in part permitted by the US Army Corp of Engineers to discharge to these wetlands, first, on the basis of good design performance of the site detention pond, and, second, on assumptions that snowmelt flooding of the portion of the wetlands into which the Spruce site would discharge would provide important additional—and adequate—dilution. Some sampling was performed along the discharge flow path through the wetlands to test these assumptions and to comply with site monitoring specified in the site's conditional use plan (MOA, 2010).

Chloride concentrations discharged from the Spruce site distributary weir showed seasonal patterns that are typical of Anchorage snow disposal sites. An early peak was followed by a rapid and steady fall in chloride concentrations as later site snowmelt diluted the chloride leached early in the season. The detention pond was effective at minimizing the magnitude of the peak when comparing 2013 results at this site with peak chloride concentrations (600 to 1000 mg/l) at sites without detention ponds, or for 2013 results measured at Tudor where chloride was measured before the effects of any pond dilution.

Despite the good performance at Spruce in 2013, given year- and site-specific conditions, chloride treatment performance measured still appears to suggest some need for site modification. This is particularly the case given that this site, unlike Tudor, does discharge its meltwaters directly to a high-value receiving water, the wetlands to the east of the site. Factors important in normalizing chloride treatment performance observed in 2013 to probable mean year performance at this site include the following. Source snow hauled to the Spruce facility is assumed to have relatively low initial chloride concentration. Snow hauled to this site is primarily from residential streets maintained by the MOA. The MOA stores all its winter sand in warm storage and as a result has significantly reduced the amount of salt that it applies to streets during winter street sanding. In addition snowfill placed in the Spruce facility during the winter of 2012-2013 occupied less than about 1/10th of site's total capacity. As a result the total snow footprint over which salt leaching could occur was at a minimum. Finally, operational performance was good—the snow had not been high-stacked. These factors all tend to increase expectations of a low peak chloride concentration, closer to 50 mg/l rather than the 130 mg/l actually measured.

Figure 11: Fall ice depleting dry volume of Spruce detention pond

A major reason 2013 peak chloride concentrations may have been elevated relative to anticipated performance is likely reduction in designed dry capacity of the Spruce detention basin as a result of a considerable fraction of the total basin volume lost to ice frozen into the bottom of the basin early in the winter of 2012-2013 (Figure 11). At our 2012 pre-winter inspection, pond water from late fall rains had become frozen and occupied about 40% of the basin dry capacity as ice. A drain was installed as part of pond design to allow seasonal draining but the drain had been installed several feet above the pond bottom. The pond-bottom ice that had formed in the fall of 2012 did not thaw and lift from the pond bottom until about mid-May, well after peak chloride leaching had taken place and discharge from the pond had begun. As a result the maximum opportunity for dilution of the early peak chloride release was lost and peak chloride concentrations discharged from the site were increased over what site design and 2013 conditions would predict. Chloride release under similar lost dry capacity conditions in a normal snowfill year could result in dramatic increase in peak chloride release to the eastern wetlands.

Nevertheless, with the single possible exception of a measurement taken of waters sampled from a wetland location to the west of the site (Spr_Wet5), chloride concentrations measured in 2013 did not represent a significant potential for impact to wetlands receiving site meltwater. The Spr_Wet5 location is in the wetland west of the snow disposal site and just south of the north gate to the site. This sampling station is at the lower, discharge end of the wetland bordering the west side of the snow disposal site. A single measurement taken at this station in late June revealed an anomalous (elevated) chloride concentration in wetland water of about 120 mg/l. It would be irresponsible to infer too much from a single measurement such as this, but this sampling station's location relative to the underlying original westward ground slope of the snow disposal site requires that it be noted. Of course, it may be that the chloride measured at this station was from a source other than the snow disposal site or that the measurement was non-representative. However its location (generally upgradient of other source area flowpaths), the time of sampling (well after snowmelt runoff from adjacent roadways), and the subsurface configuration of the snow site can not exclude the snow disposal site as a possible source.

In fact, hydraulic evidence for leakage and discharge as shallow flow into the western wetlands is theoretically valid. As no surface flows across the detention pond weir occurred during the 2013 melt season, discharge from the site (as discussed earlier in the turbidity section of this report) took place as subsurface leakage across the GCL (detention pond clay liner). Substantial fill was placed over the site to bring it to grade so that in the vicinity of the detention pond the fill is unsaturated and overlies an original ground surface sloping, at least in part, towards the western wetlands. As discussed earlier, leakage across the liner appeared to be taking place preferentially through the weir/liner interface, and the intrinsic hydraulic conductivity of the liner is very small (specified as less than $5x10^{-9}$ cm/sec, CETCO, 2008). However, given the finished site configuration, some fraction of meltwater flux through the liner will be directed to the west along the surface of the westward sloping low-permeability sediments comprising the original ground and thus may be the source of the chloride measured at Spr_Wet5. Though the magnitude of chloride concentration measured at this station was relatively small, additional sampling to resolve presence and source of any such leakage is warranted.

In any event chloride impacts to the receiving wetlands appeared de minimis in 2013. Visual inspection of measurements made after leafout (late May-early June) of chloride concentrations at the site outfall (Spr_WR2), at points along the wetland discharge flow path, and at background locations suggest no apparent difference between wetland waters along the discharge flow path and at background locations (Figure 10). Small-sample Wilcoxon rank-sum tests comparing measurements along the wetland discharge flow path and background wetland locations also suggest no difference in sampled populations. Chloride concentrations measured at these location in 2013 were also well below chronic and acute thresholds recommended by Chmielewski et. al. (1998) for wetlands receiving snowmelt from Anchorage snow disposal sites. They and others (Hansen, 2001) point out that brief exposures to modest chloride concentrations early in Anchorage's growing season may not normally represent a practicable threat to wetland plant ecosystems. However this is dependent upon chloride type (with a magnesium chloride type that is predominant at this site representing a larger threat) and extent and duration of inundation. Prolonged seasonal inundation has long been in effect at these wetlands due to damming of area snowmelt against an access road crossing the drainage path of the wetlands. Dead spruce trees (snags) seen in Figure 12 near wetland sampling station Spr_Wet0 and immediately adjacent to the site outfall were present at the time of site construction and are likely the result of this seasonal history of inundation. However, as Chmielewski et. al. (ibid.) points out, combined stresses

Figure 12: Inundation effects on spruce trees at Spruce outfall

from both inundation and chloride can have a much larger effect than either individually. Given this, continued good operation of this site and repair of the pond drain to ensure that optimum dry capacity is present prior to freezeup will be critical to achieving continuing minimal impact to the receiving wetlands.

Site pH

Finally, we measured the pH of site meltwaters at both sites during our 2013 investigation (Figure 13). The pH of meltwaters at the Tudor site was uniform and approximately neutral throughout the investigation, reflective of all previous measurements WMS and others have made of meltwaters at Anchorage snow disposal sites. This was mysteriously not the case at the Spruce site. Early in the season pH at Spruce closely matched our results at Tudor but in mid-May pH rose sharply and then began a gradual decline. By the end of the season the pH of both pond and site discharge waters had re-attained a pH characteristic of meltwater from Anchorage snow disposal sites. During the rapid pH rise, samplers measured meltwater flowing across the pad surface as it originated from the snowfill and from ponded water impounded on the pad upgradient from (above) the detention pond. All these measurements showed near neutral pH so that we excluded the snowfill itself as a source of the high pH.

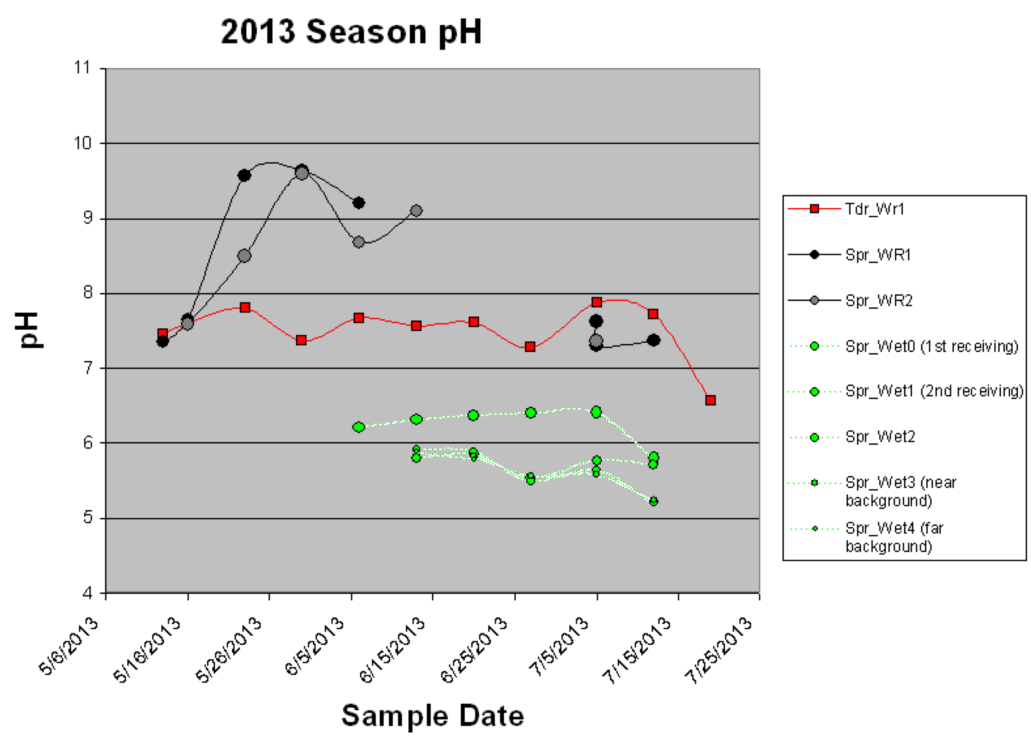


Figure 13: pH in snow meltwater at 2013 sites

Though we were not able to definitively resolve the source of the elevated pH measured in 2013, we concluded that it was an artifact of new materials placed at the site during just-completed construction. Inspection of chemical composition of a landscape spray excluded this as a likely source. Very rapid onset of the pH rise coincident with spring release of the ice frozen to the pond bottom suggested subdrain materials or the GCL as the most probable source of the elevated pH. In any event, pH declined steadily over the spring and summer and reached neutral conditions by mid-summer. Inspection of pH measurements made along the wetland discharge flowpath and at background locations suggest that pH of the wetlands became moderately elevated near the point of meltwater discharge to the wetlands (Spr_Wet0). However, northern wetlands typically have a high buffering capacity (Post, 1996). By the middle of the summer the plume of elevated pH had substantially attenuated as evidenced by serial changes in pH measured at Spr_Wet0 and Wet1. Given the exclusion of the snowfill as a source and the steady decline of pH in the meltwaters to a more typical neutral level, we believe that an interpretation of new construction materials as a source to be a reasonable inference. Additional monitoring could readily confirm this. However for the long-term, we do not anticipate meltwater pH values at this site that are markedly different from those at other Anchorage snow disposal sites.

Part 4 – Conclusions and Recommendations

In 2013 WMS completed investigation of the performance of V-swale snow disposal site technology at two Anchorage sites, the Tudor Snow Disposal Site and the Spruce Street Snow Disposal Site. The primary purpose of the investigation was to assess performance, from a water quality treatment perspective, of V-swale snow disposal site design technology. Current V-swale design includes incorporation of aligned and sloping pad geometry (V-swales and lateral drainage channels) that control for particulates, and detention basins that control for chloride (based on assumptions of source snow chloride content and a maximum snowfill depth and volume). As a basis of evaluation, WMS compared water quality treatment performance of flat-pad sites and experimental V-swale installations (as reported in previous studies) in controlling discharge of particulates and chloride (Table 1) to that measured in 2013 at the two currently operating V-swale sites. Performance at the two investigated V-swale sites was also evaluated in context with site conformity with V-swale design and operational criteria (Appendix A). This report part briefly summarizes conclusions and recommendations relative to further implementation of V-swale technology at Anchorage based on the results of the 2013 investigations.

Performance Observations	**Early Melt**	**Mid-Melt**	**Disintegration**
No Practices			
Turbidity (NTU)	150-350	350-500	>1,000
Chloride (mg/L)	1,000-10,000	100-500	<100
Shallow Ponding			
Turbidity (NTU)	70-150	150-300	>500
V-Swale			
Turbidity (NTU)	10-50	10-50	<200

Table 1: Snow Disposal Performance at Anchorage

Conclusions

V-swale snow disposal site designs, where implemented and operated according to standard criteria, show significant improvement (one to two orders of magnitude) in treatment and removal of particulates and chloride over all other flat pad designs used at Anchorage. Investigation of two existing sites using V-swale technology at Anchorage in 2013 clearly demonstrates this conclusion.

Of the two sites investigated, Tudor, designed and constructed in 2004, includes serious design flaws and in 2013 was operated counter to all standards established for V-swale designs. As a result, control of particulates at this site was no better than that measured previously at most flat-pad sites. Chloride in meltwater discharge at this site (where the detention basin was not sized to match site snow source and volume) also reflected peak concentration similar to that measured at any uncontrolled flat-pad site.

Spruce, constructed in 2013, was well designed, fully incorporated all V-swale concepts and added subdrains and an overlap of detention pond and snowfill to improve performance. The site was also operated in 2013 in conformance with all operational standards and as a result performed very well. It fully met performance estimates established during concept development for controlling sediments, reducing turbidity (as a surrogate measure for suspended sediment concentration) in meltwater over that of flat-pad sites by an order of magnitude. It also included a detention basin designed for source snow characteristics and volume and performed well in reducing peak chloride in site discharge. However, a flaw in seasonal pond drain-down capacity and some possibility of loss of some fraction of meltwater to fugitive subsurface flows suggest some additional modifications to this site may be required.

In general, the 2013 investigation confirms the utility of V-swales when properly designed and operated, and their continued design and use at Anchorage is highly recommended. However results also re-emphasize the synergy between design and operation that was expressed in original design concept development documents. For even the best-designed V-swale site, poor operation may actually increase pollutant release over that of a flat-pad design, indicating a need for careful operational oversight if these facilities are to remain controls, and not sources, of site pollutants. With this in mind, sequential placement of snow from bottom of a V-swale to the top, compact placement of snow at uniform depths and across the full width of individual V-swales, rigorous attention to the setback of any snowfill from lateral and end channels, and stacking of snowfill no higher than the specified threshold are basic operational procedures that must be followed for successful performance. Finally, 2013 observations provide insight into future design modifications that can improve V-swale performance as well identify specific modifications that will improve the existing evaluated sites. These recommendations are summarized briefly below.

Tudor Site Recommendations

Tudor was designed as the first V-swale facility at Anchorage; designers did not have an advantage of prior experience. As a result of the early design errors this engendered, design elements at this site may actually increase particulate mobilization rather than treat it. The effects of the design flaws proved particularly fatal when combined with the poor operational practices used at this site in 2013. These operational errors appear to be due in part to lack of any oversight for or knowledge of water quality operational requirements. Lack of oversight may be exacerbated by shared use of this site by both DOT and MOA maintenance agencies, with DOT as non-owner having no ‘pain in the game’ to provide incentive to operate the facility correctly. Therefore improved operational practices may require annual training and vigorous oversight, along with some incentive for greater DOT dedication to participate. In any event, improving performance at this or any site through structural improvements alone will not be successful unless a commitment is made to V-swale operational standards.

That said, structural improvements required at Tudor are not trivial. Basic required improvements include:

- realignment of V-swales to reduce width asymmetry,
- reconstruction of axial and lateral channels including use of washed rock placed at or just above the pad surface elevation,
- construction of subdrains along lateral channels,
- armoring of the base of containment berms,
- replacement of discharge weirs including use of buried seepage cutoff walls,
- resizing of the detention pond to match source snow and volume, and
- re-grading and armoring of all discharge channels including those running from V-swale discharge weirs to the detention pond.

Fortunately, in an average year (including 2013) meltwater from the site infiltrates and discharges along shallow ground water paths to a small stream a short distance west of the site. These serendipitous conditions generally guarantee best particulate control. Given this, until site conditions change such that infiltration no longer occurs, prioritization of this site for retrofit should probably remain low. The only improvements that may accrue immediate water quality benefits include reconstruction of the detention pond to reduce current chloride impacts to the receiving stream, though current impacts appear quite low.

Spruce Site Recommendations

Spruce is a very carefully designed V-swale facility that incorporates several design concepts suggested but not implemented in early design criteria development. The site receives source snow that has a relatively low-salt content which undoubtedly contributed significantly to measured performance. However the site was also very carefully operated in 2013, including good stacking practices and careful placement of snow outside lateral channels; the importance of this operational attention to detail to success cannot be overemphasized.

However additional V-swale design elements not included in the Tudor site were also important in 2013 performance and should be incorporated into future design criteria. These include incorporation of lateral and axial subdrains and pad configuration that overlaps the lower end of the snowfill footprint and the upper end of the detention basin. This (along with careful attention to uniform placement of snowfill starting at the lower end of the V-swale axis) precludes any erosion from the last meltwater flowing across sediments, as the last snowfill collapses directly into the ponded water. Lateral subdrains (again importantly kept completely free of snowfill) also provide paths that are armored against sediment mobilization for meltwater flow. Use of larger washed rock as armor and placement of the channel surface at the same elevation as the adjacent pad surface also prevents the channel armor from being buried by released sediment.

The Spruce street site also includes a detention pond that was explicitly designed to detain the early volume of high chloride concentration meltwaters. The design method estimates the required detention pond dry volume on assumptions of average chloride load in the source snow, the maximum snowfill depth allowed for the site, the total volume (footprint) of snowfill, and the sensitivity of the receiving waters (i.e., the permitted chloride concentration at the site outfall). At the Spruce site, the design assumed the full basin volume would be available at the start of snowmelt as dry volume through the incorporation of a manual drain that would allow complete seasonal (end of fall) drain down of the pond.

Though the Spruce site performed very well in 2013, it did so under a load representing only a small fraction of the site's total capacity. Some additional structural flaws in design and construction of this site also suggest its 2013 measured performance may not represent its mean performance capabilities. The Spruce site design as described earlier assumed a dry basin and included a basin liner to manage and direct site meltwater flows. However the pond drain was installed well above the pond bottom, presenting a potential for loss of a significant fraction of the designed dry capacity to ice (which in fact happened in 2012-13). Also, though no flows exited the site over the pond weir, observations suggest that a significant fraction (if not most) of the meltwater generated at the site discharged at the interface of the pond liner and the smooth weir face. However, limited data and known relationships of pad fill and original ground also suggest that the pond liner design and pad configuration may result in some fugitive loss of high chloride concentration meltwater to the west wetlands, potentially significantly reducing the desired effect of the detention pond. Finally, lack of armor on the outside face of the distributary weir and lack of a fixed elevation along the weir crest resulted in a single, concentrated pour point across the distributary weir face. We recommend addressing these issues as follows:

- Install a fixed-elevation serrated weir support across the outside face of the distributary weir. Place and armor the outside face of the weir so as to tie into the adjacent undisturbed wetland surface.
- Re-install the pond drain at an elevation that will allow complete seasonal draining of the pond water.
- Implement water quality monitoring of wetlands adjacent to the site outfall (distributary weir) and at selected station(s) at the west wetlands (as required by the site conditional use permit) sufficient to assess adequate chloride treatment (east wetlands) and containment of unsaturated flow through the liner and fill (west wetlands). Based on monitoring results, it may be necessary to consider installation of additional pond liners and/or subdrains that can capture and convey fugitive flows to acceptable dilution and discharge.

General Recommendations

The follow recommendations reflect general findings from our 2013 investigation relative to V-swale use, design and operation. We recommend the following be addressed and implemented as additions or amendments to Municipal design criteria language and guidance:

<u>Applications</u>

- V-swale type snow disposal facilities provide effective treatment of particulates and chloride in meltwater from Anchorage snow disposal sites. Treatment is passive and therefore very low cost when compared to other treatment options. The design and site practices described for this type facility should be required and implemented at all Anchorage snow disposal sites, including implementation and close supervision of V-swale-specific operational practices.

<u>Design</u>

- Avoid widely varying widths along the axis of a V-swale and maintain generally linear lateral channels.
- Use drain rock or similar as channel armor; place the surface of the armor above the adjacent pad surface by about the d50 of the armor rock.
- Place rock subdrain wrapped in filter cloth along the full length of all V-swale lateral and end channels.

- Place subdrains along the V-swale axial channels as follows: along the lower 50% of each axial channel length place non-perforated pipe at the base of a rock subdrain; along the upper 50% of each axial channel length place perforated pipe at the base of a rock subdrain with an impermeable liner laid horizontally across about 150% of the width of the subdrain trench; join subdrain pipes.
- Where feasible, place detention basin to overlap lower end of snowfill footprint (lower end of snowfill is placed inside footprint of pond at weir overflow stage)
- Design detention basin with a dry capacity approximately equal to an early melwater peak chloride release volume based on chloride leaching at mean Anchorage spring temperatures, average chloride load of source snow, mean maximum volume of stored snow, mean maximum snowfill depth, and regulatory-defined receiving water sensitive to chloride
- Design detention basin with a total rate over the pond footprint of fugitive loss of meltwater through infiltration of less than 1% of the site average meltwater rate.
- Install pond drain pipe adequate to drain pond to designed dry volume capacity
- Install stabilizing shrub vegetation around pond perimeter, setback 5 feet from maximum pond stage to allow pond bank access and litter removal. Armor 5 foot setback to limit wave erosion and vegetation encroachment along access path.
- Place weirs at the lower end of each V-swale where snowfill footprint does not intersect detention pond. Place weirs at the discharge point of all detention basins. Place fixed elevation distributary weirs at discharge point to receiving waters.
- Design all weirs as sharp-edge weirs with a freefall discharge and employing seepage and cutoff walls limiting seepage loss to less than 1% of average meltwater discharge rate.
- Place permanent setbacks markers not more than 2 feet inside all lateral and end V-swale channels
- Prepare operations manual including site-specific water quality operational requirements (maximum threshold snowfill depth, permitted receiving water chloride concentration, site maps including weirs and drain plug locations).

<u>Operations</u>

- Place snowfill across full width of each V-swale
- Place snowfill at uniform height over entire site; where snofill is vertically staged, place lower stage over entire site before placing second stage.
- Place snowfill no higher that the maximum threshold height established in site design.
- Place all snowfill in compact fill; do not place isolated snowfills.
- Do not encroach any lateral channel with snowfill
- Do not ‘wing’ snowfill out at site perimeters
- Coordinate multi-management use to ensure optimum operations

<u>Maintenance</u>

- Pre-spring melt - cap the detention pond drainline
- Spring melt - inspect surface channels for snow and ice blockage
- Spring melt – inspect backwater for potential fugitive and outburst flooding

- Post snowmelt - drain pond and remove litter from detention pond
- Post snowmelt - rake and clean channel armor
- Post snowmelt – grade pad sediment adjacent to channels to below armor d50
- Post snowmelt - inspect and repair channel and berm erosion
- Pre-winter - drain the detention pond prior to freezeup
- Pre-winter - present annual site operations training
- Pre-winter - renew and revise cooperative operations agreements
- Winter – supervise site fill operations to ensure V-swale SOP

Monitoring

- Responsibilities – assign site-specific WQ monitoring roles and responsibilities
- Monitoring plan - establish site-specific WQ monitoring plan including monitoring goals and objectives; sampling parameters, stations, and schedules; recommended actions and schedule; and annual report and recipients list.
- Monitoring response – schedule post-monitoring inspection and report any mitigation action

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Appendices

Appendix A - V-Swale Technology

Appendix B – Anchorage V-Swale Site Designs

Appendix C - 2013 Sampling Stations

Appendix D - 2013 Data Summaries

Appendix E - 2013 Field Logs

ANCHORAGE SNOW DISPOSAL SITES: 2013 EVALUATION

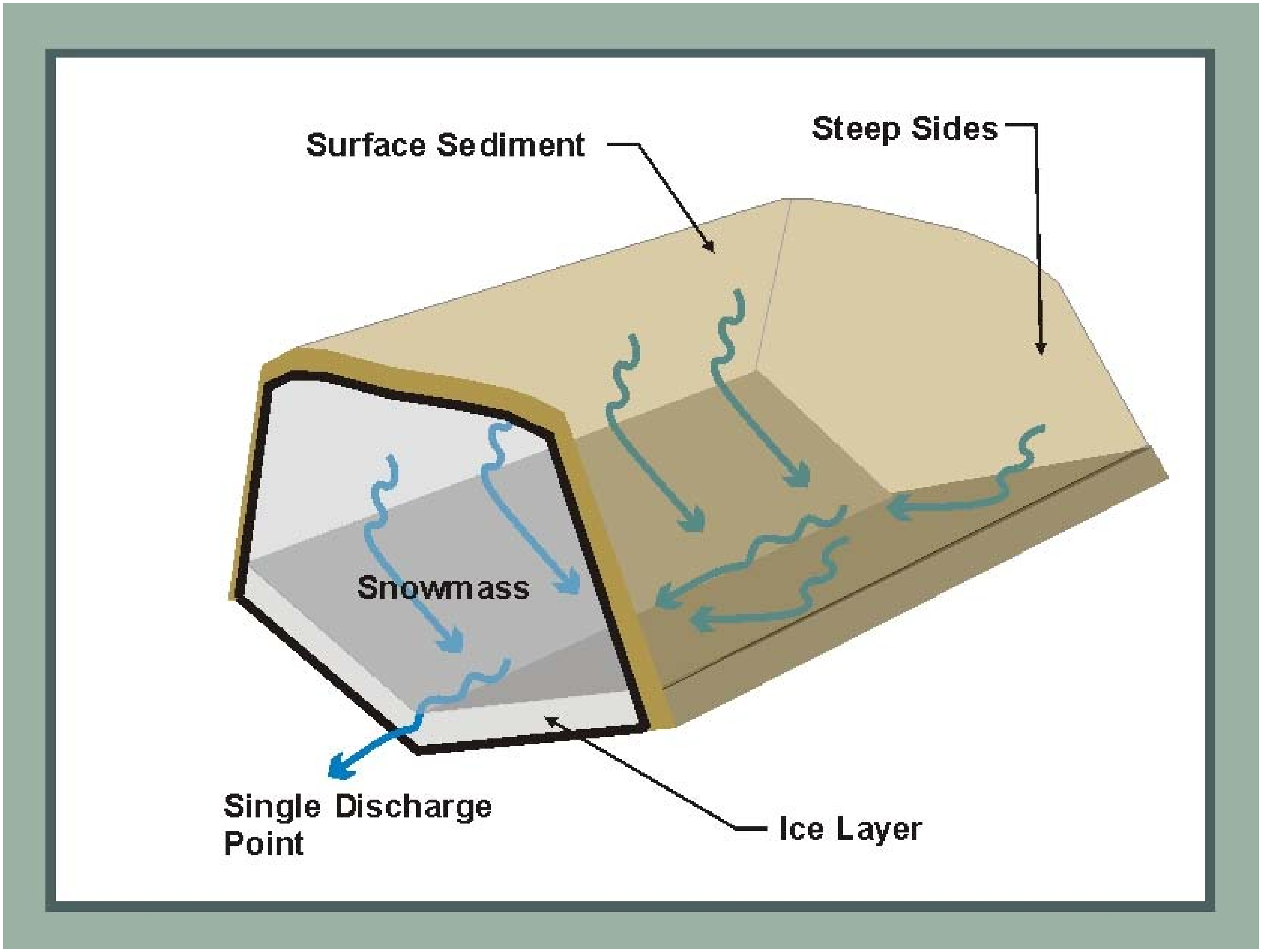
Document No.: WMP ARr14002
WMS Project No.: 95004

Appendix A – V-Swale Technology

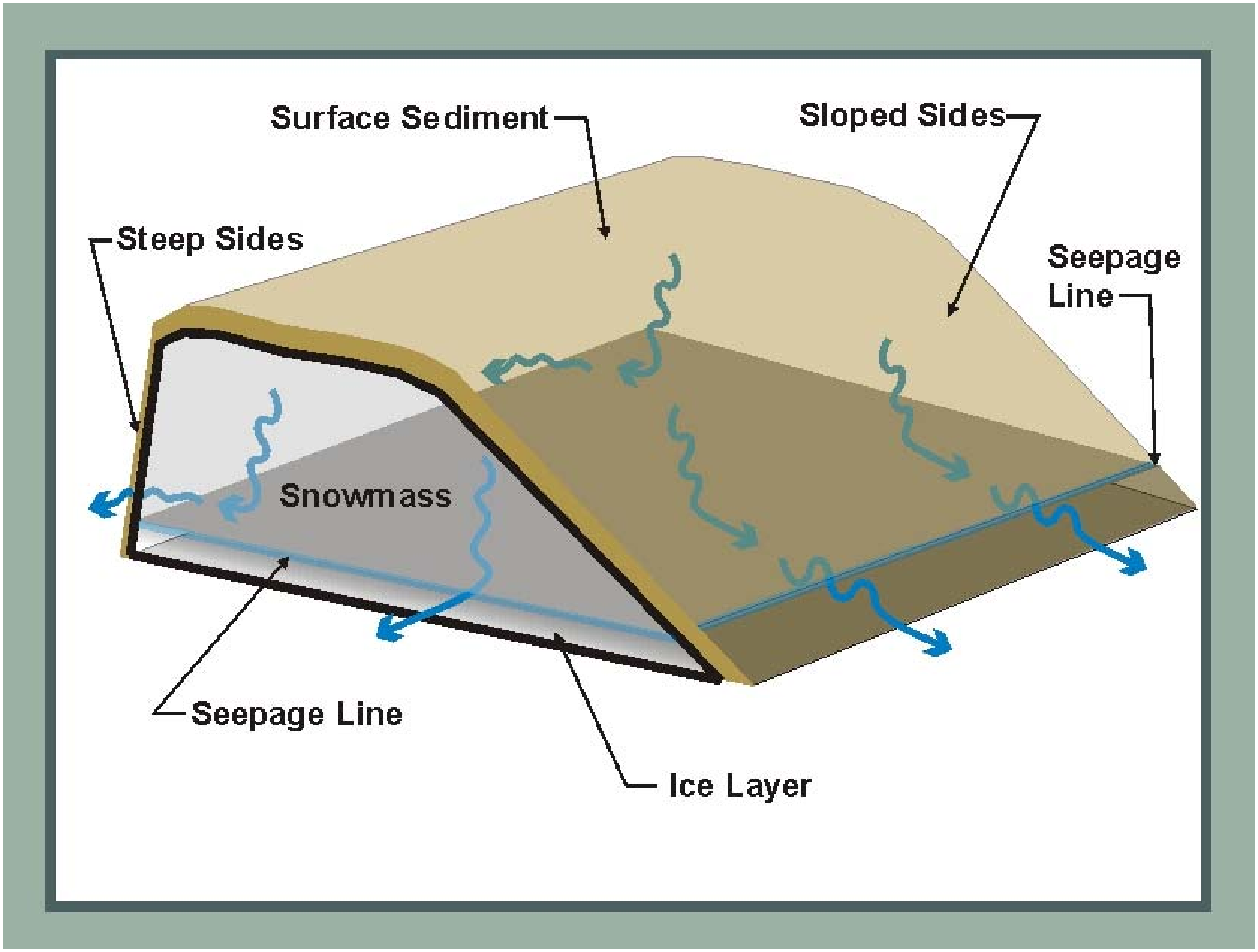
Contents:

1. V-Swale Physical Processes Diagrams
2. V-Swale Operations guide
3. V-Swale Description

‘V-Swale’ Pad Configuration’

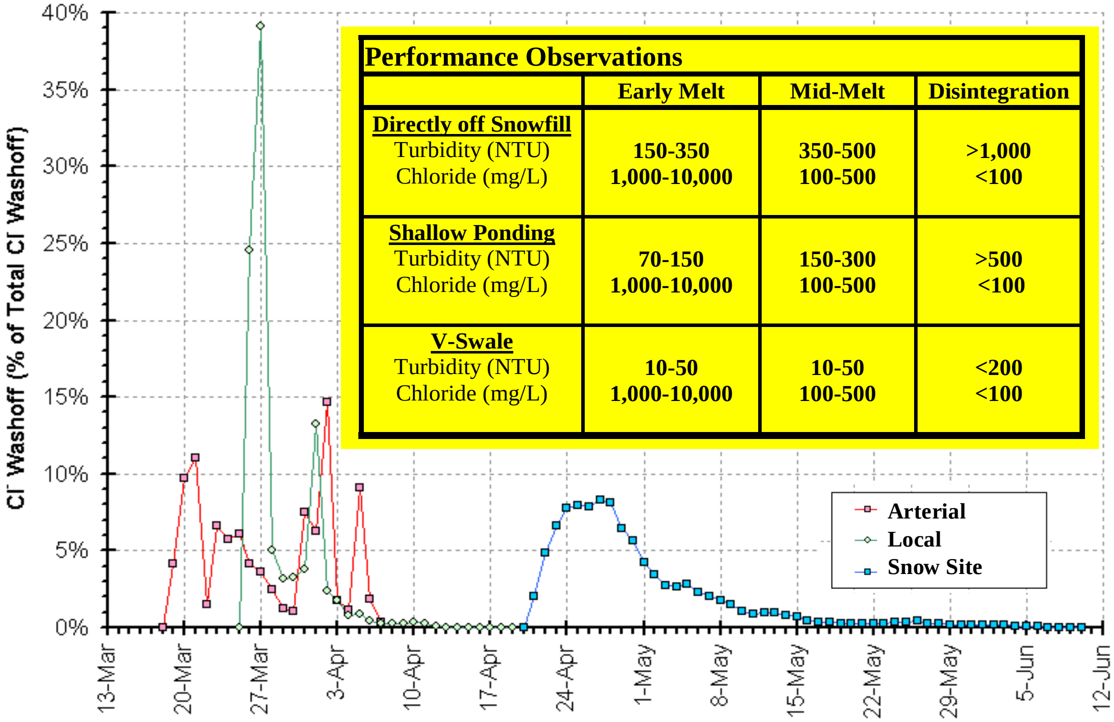


Conventional Pad Configuration



Snow Storage Practices Performance

SUMMARY OF RESULTS

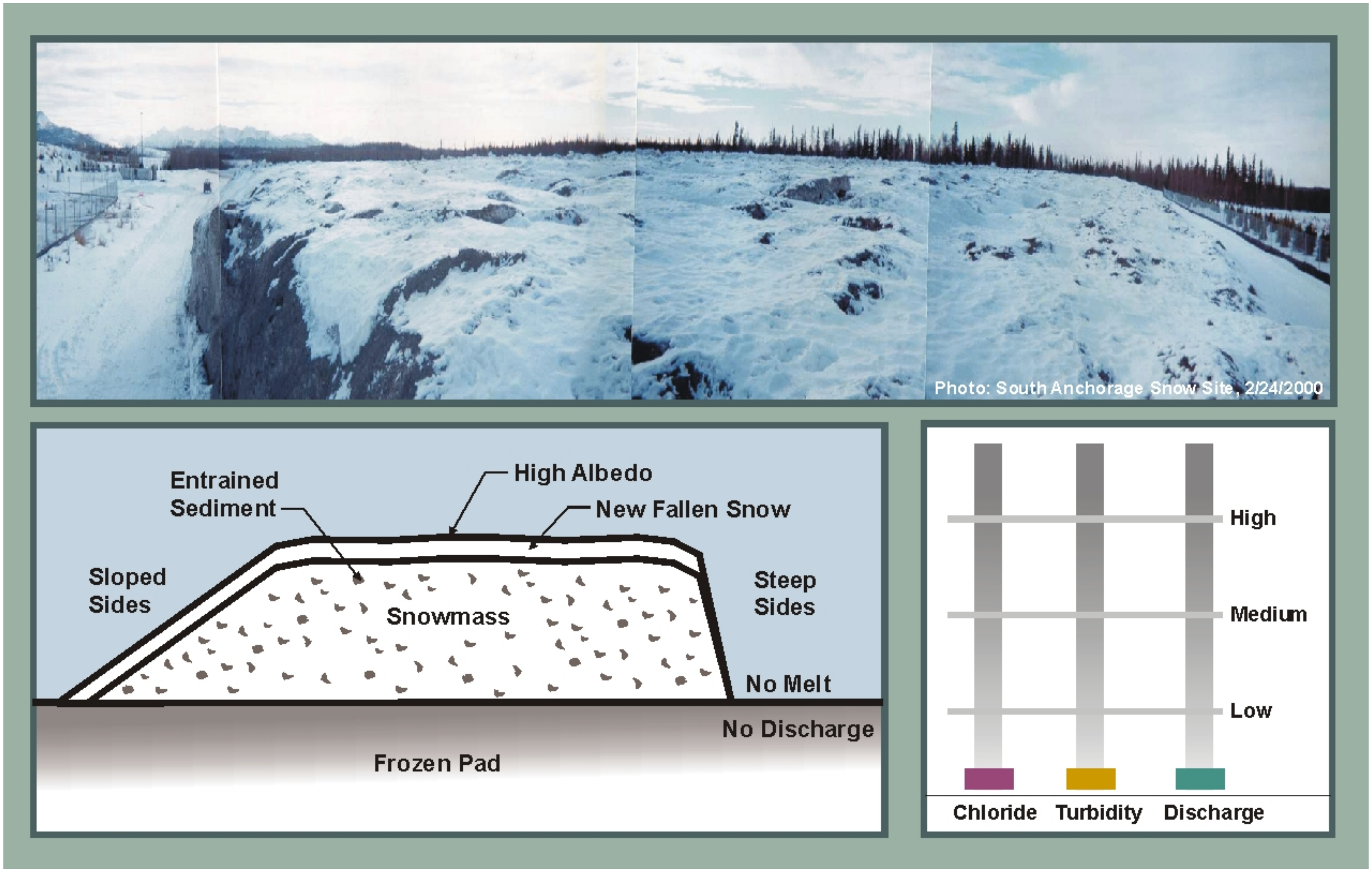


Performance Observations

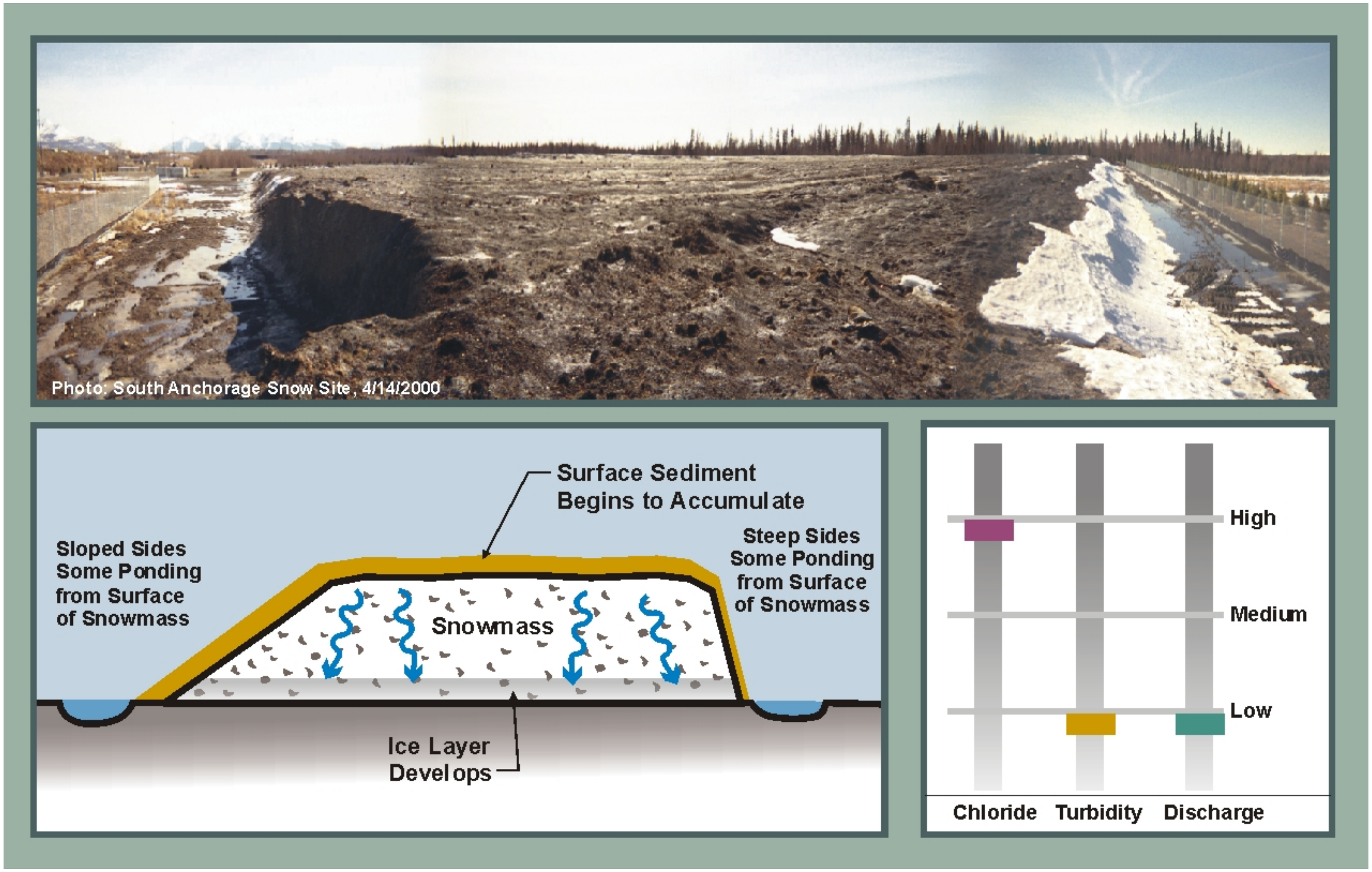
	Early Melt	Mid-Melt	Disintegration
Directly off Snowfill Turbidity (NTU) Chloride (mg/L)	**150-350** **1,000-10,000**	**350-500** **100-500**	**>1,000** **<100**
Shallow Ponding Turbidity (NTU) Chloride (mg/L)	**70-150** **1,000-10,000**	**150-300** **100-500**	**>500** **<100**
V-Swale Turbidity (NTU)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

Five stages in snow fill melt and disintegration. Pictures shown are for flat, uncontrolled 'conventional' pad. Process remains the same for V-swale but flows are controlled by a combination of pad orientation and configuration, and snow fill placement practices.

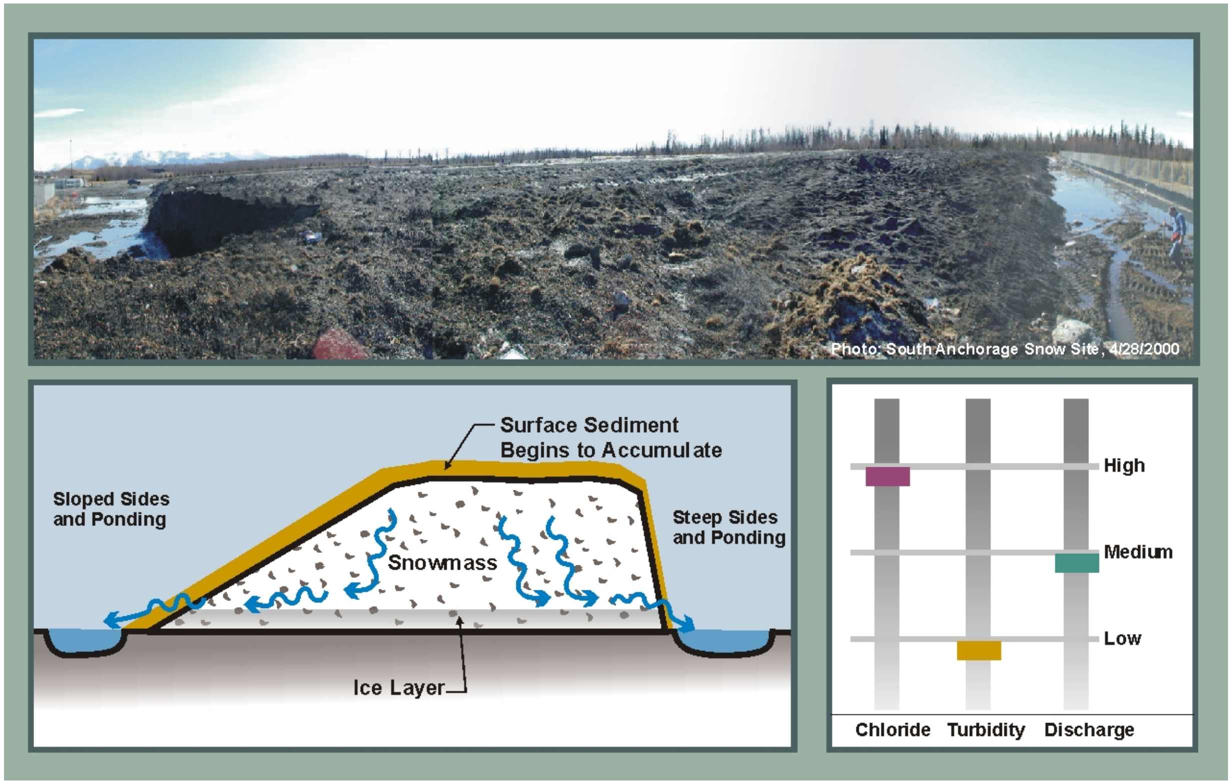
Stage 1: Late-Winter Snow Fill Prior to Melt



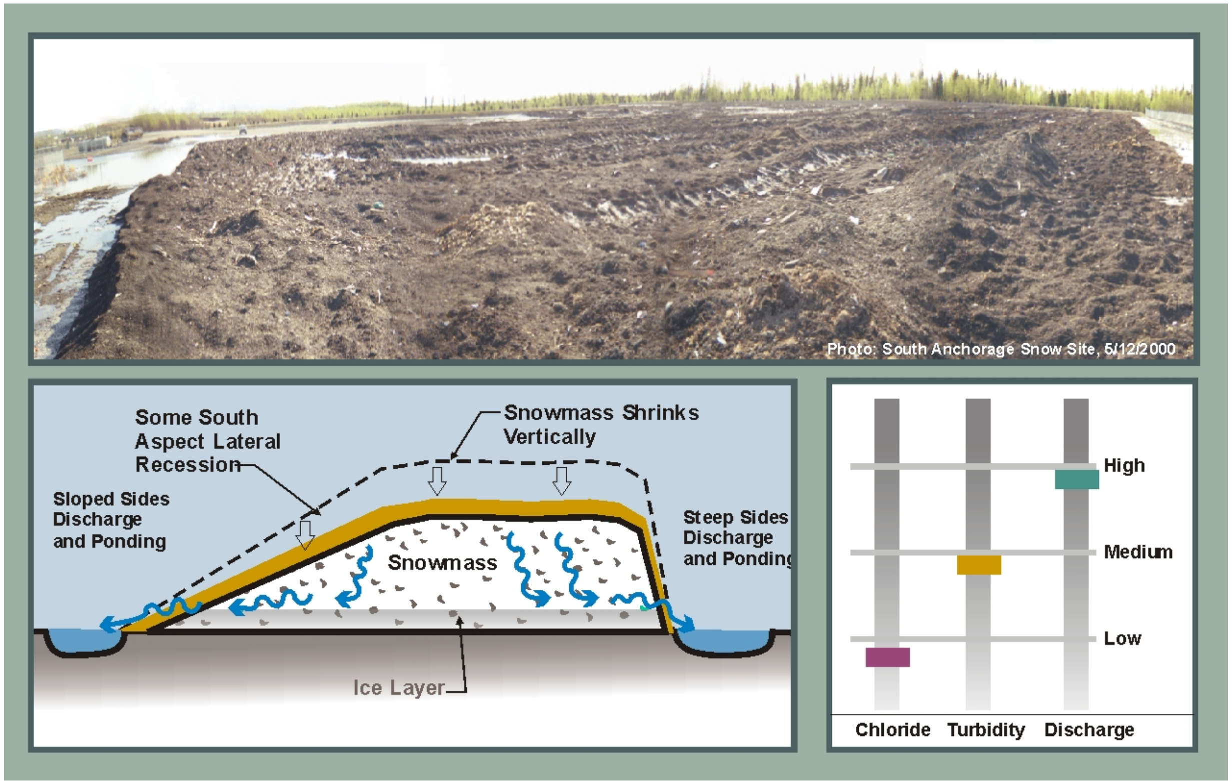
Stage 2: First Melt and Snow Fill 'Ripening'



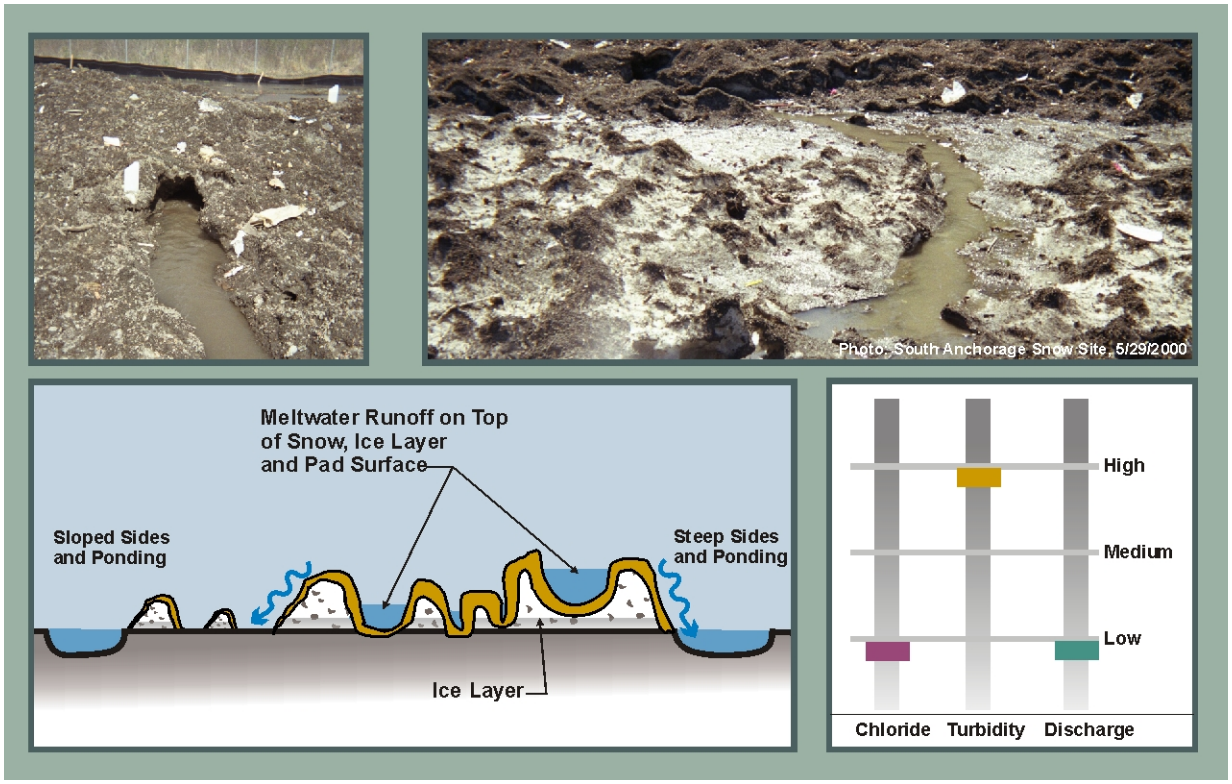
Stage 3: Chloride Leaching and First Meltwater Flows

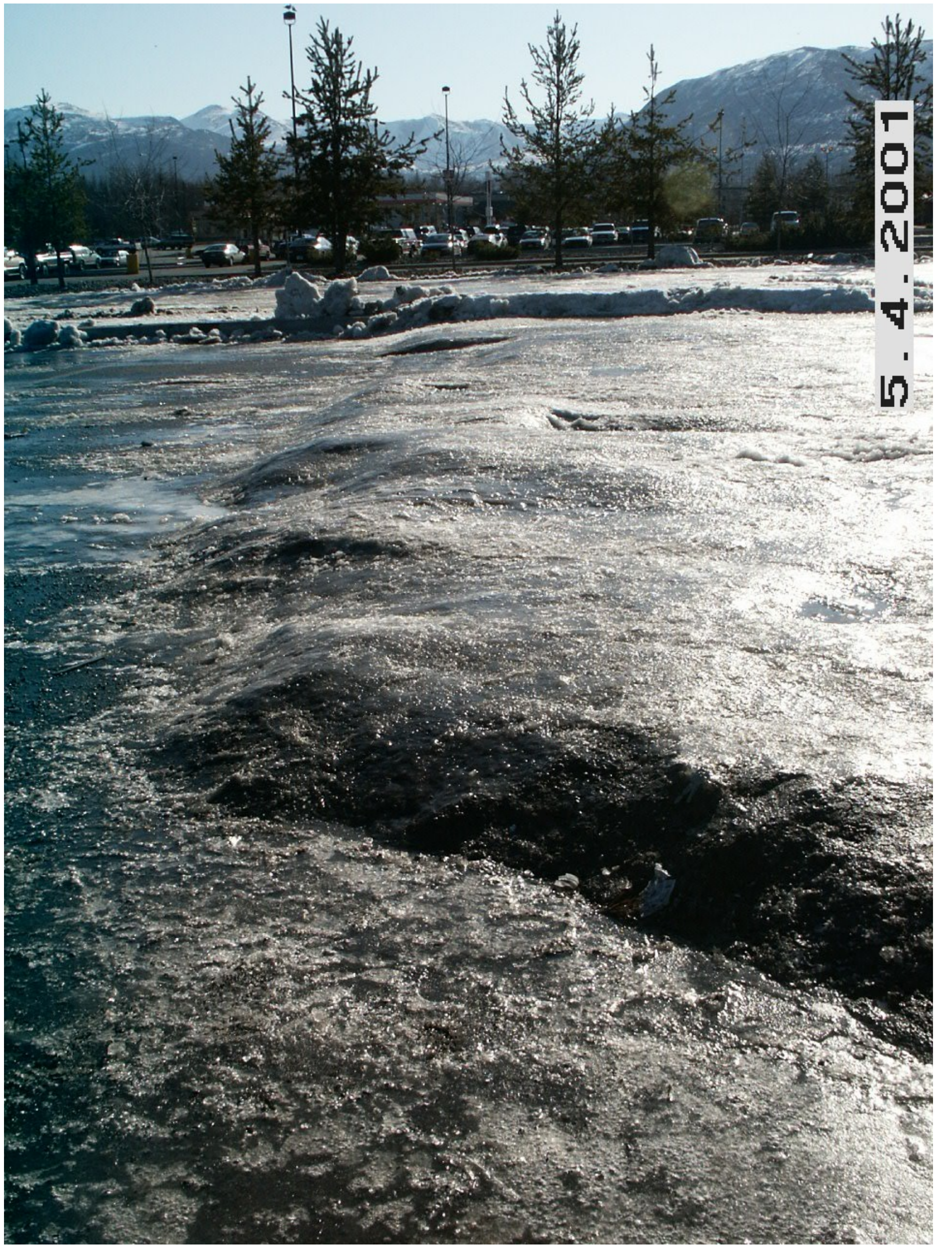


Stage 4: Snow Fill Deflates Vertically



Stage 5: Snow Fill Collapses and Basal Ice Eroded

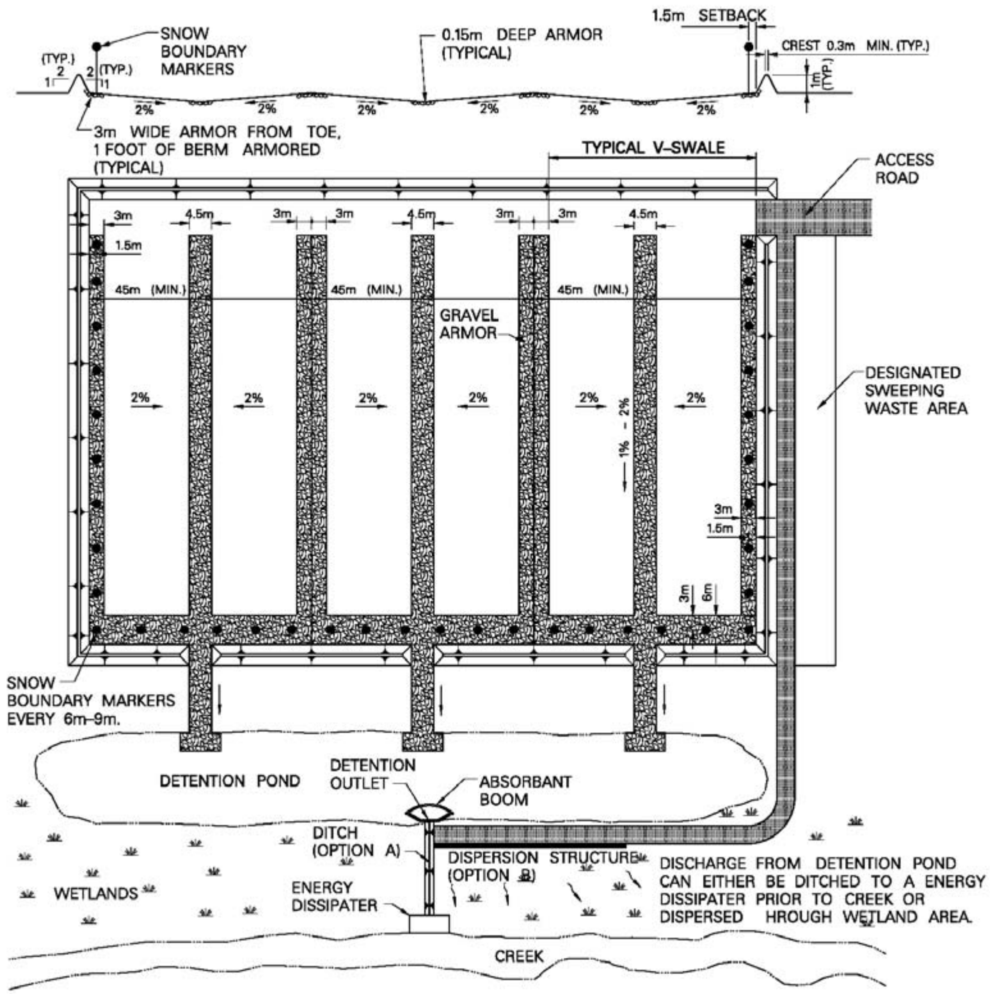




Basal Ice at Parking Lot Snow Storage (snow fill removed)

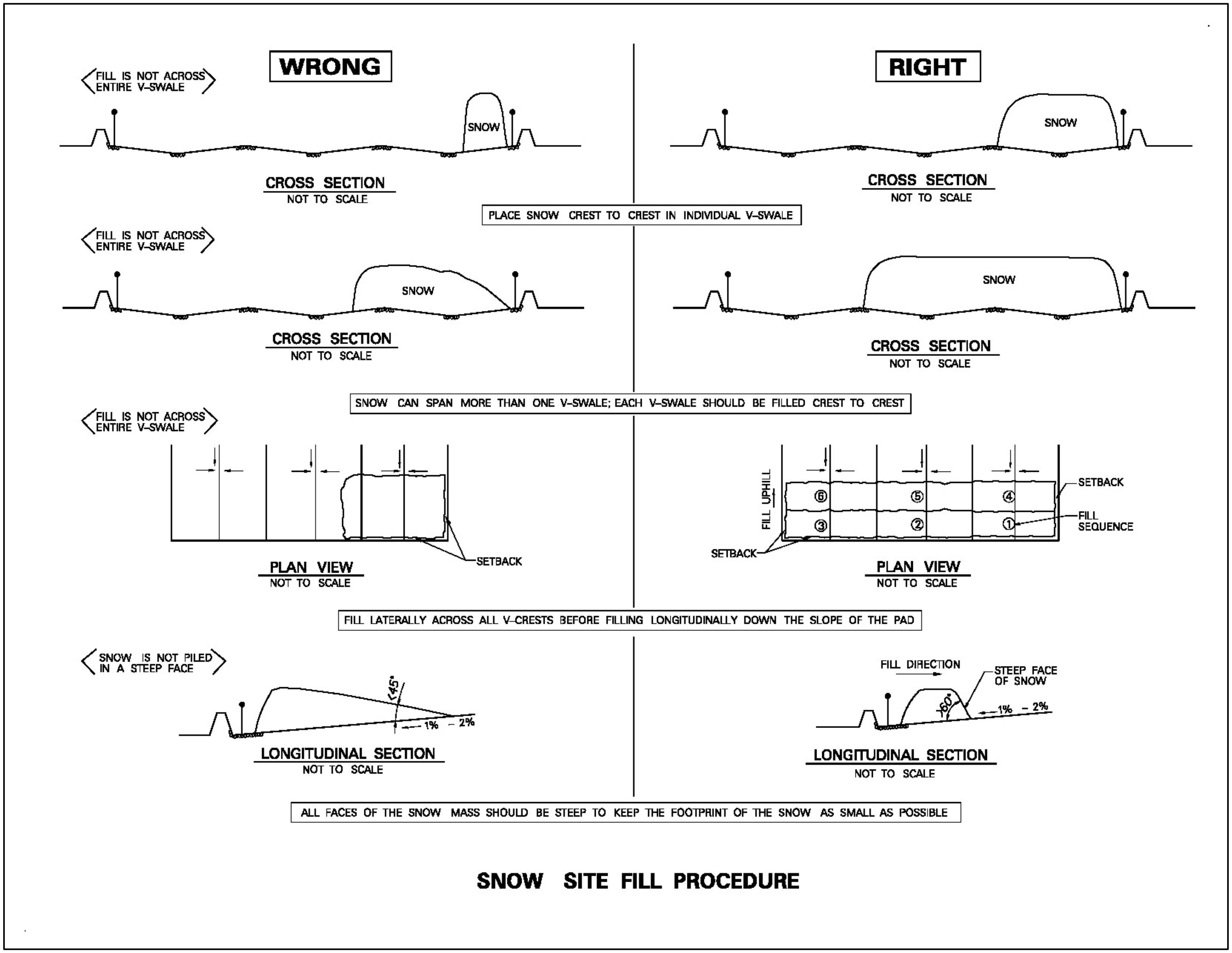
2012 MOA V-Swale Design Criteria

(this does not include recommendations made in 2013 evaluation report)



2012 MOA V-Swale Operations Guidance

(this does not include recommendations made in 2013 evaluation report)



SITING, DESIGN AND OPERATIONAL CONTROLS FOR SNOW DISPOSAL SITES

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ABSTRACT: The Municipality of Anchorage, at 61^{o} north latitude, plows and hauls snow from urban streets throughout the winter, incorporating grit and chloride applied to street surfaces for traffic safety. Hauled snow is stored at snow disposal facilities, where it melts at ambient spring temperatures. Municipal studies performed from 1998 through 2001 show that disposal site melt processes can be manipulated, through site design and operations practices, to control chloride and turbidity in meltwater. An experimental passive 'V-swale' pad configuration tested by Anchorage investigators reduced site meltwater turbidity by an order of magnitude (to about 50 NTU from the 500 NTU typical of more conventional planar pad geometries). The Municipality has developed new siting, design and operational criteria for snow disposal facilities to conform to the tested V-swale pad configuration.

KEYWORDS: Urban Snow Control, Snow Storage, Snow Disposal, Snowmelt, Design Criteria

INTRODUCTION

Economical and effective control of pollutants released from snow disposal sites serving high latitude communities presents problems peculiarly reflecting the impact of a subarctic climate. At high latitudes snow plowed from streets accumulates rather than melts due to low solar insolation and daily temperature ranges that generally remain below 0^{0}C throughout the winter. As plowed snow accumulates and exceeds available storage space along streets, it is hauled to central storage areas and placed as a compact snowfill. High fuel costs usually prohibit forced melting, so instead the hauled snow is stored and allowed to melt under ambient spring weather conditions.

Pollutants contained in stored snow also reflect the effects of an arctic climate on street maintenance practices. At high latitudes, deicing often has limited use in improving road traction, and instead grit is widely applied. Salt (granular sodium chloride) is added to grit in amounts necessary to maintain fluidity during application (in Anchorage about 5% by weight of grit). A fraction of the applied grit and salt, as well as fugitive pollutants from vehicles, becomes incorporated into hauled snow. When seasonal melt occurs, the stored snowfill releases these pollutants in a complex fashion. Studies performed by the Municipality of Anchorage (MOA) over the last several years have shown that the manner in which pollutants are released strongly reflects the initial source of hauled snow, the melt processes of stored snowfill, and the geometry of storage areas and the snowfills themselves. Based on findings from these studies, the Municipality has developed effective new snow storage site design and operation practices that address control of a range of pollutants, particularly sediment.

METHODS

In 1998 MOA implemented a program to assess the environmental impacts of its winter street maintenance practices. As part of this program MOA studied the performance of four Anchorage snow disposal sites through four melt seasons, from 1998 through 2001. In the first year of study, investigators focused on seasonal melt and chloride release patterns. Meltwater sampling at the storage sites was temporally and spatially stratified to assess the effects of different snowfill and pad geometries and meltwater flow regimes (Wheaton, 1998a). Based on initial results, in the summer of 1998 MOA site operators implemented minor modifications to operational practices and drainage infrastructure at all MOA snow disposal sites (Wheaton and Jokela, 1998b). Snow pad changes included snowfill set-back staking and channel armoring. Operational changes emphasized placement of snowfill in steep, compact footprints and at downgradient positions on snow pads.

MOA investigators broadened the scope of meltwater sampling for spring of 1999. Analytical parameters sampled for that year included chloride, basic anions and cations, polynuclear aromatic hydrocarbons (PAHs), metals, particulates, and fecal coliform sampled both in the snowfill and in meltwater (WMS, 1999a; 1999b). However, it became apparent to MOA investigators early that controlling particulates would also treat adsorbed pollutants.

As a result, in spring 2000 MOA focused studies on the melt process and its relationship to changes in turbidity (WMS, 2000a). Investigators were particularly interested in ice layers formed at the base of snowfills, and changes in water quality as meltwater exited from the surface of the basal ice and traveled across the storage pad. Snowfills were cored to establish initial snow quality and to estimate the thickness and position of basal ice. Meltwater samples were collected at seepage and discharge points along the snowfill boundaries, along flow channels on the storage pad, and at offsite discharge points. Samples were tested in the field for electrical conductivity using temperature-compensated meters calibrated daily. Field turbidity data were collected using formazin-standard portable nephelometric turbidimeters calibrated at the beginning of the project. For most of these parameters, Anchorage data was consistent with that reported by others (Novotny et al., 1999; UAF, 1996). All data were documented and related to a time series photographic record of the melt process (WMS, 2000b).

Based on encouraging findings from 2000 observations, investigators became interested in the possibility of artificially shaping the basal ice beneath snowfill as a means of controlling meltwater discharge and turbidity. To test the concept, operators shaped a portion of one storage pad to have a pronounced ‘V’ cross section perpendicular to the general pad surface gradient, with the pad section designed to direct flows laterally to a central depressed axis. Over the winter of 2000-2001, site operators placed hauled snow across the full width of this experimental ‘V-swale’ and the following spring, investigators observed melt processes and collected data to assess its performance.

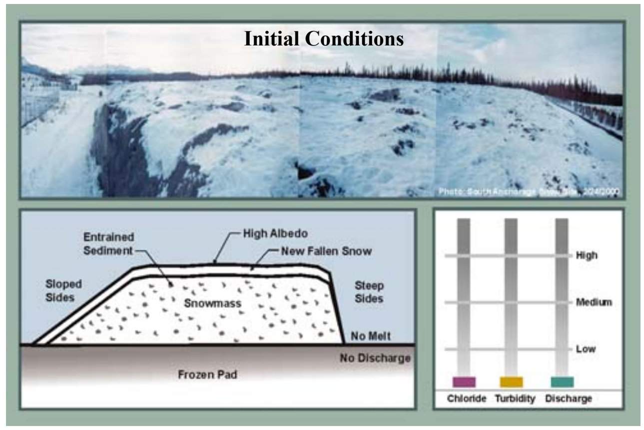
RESULTS AND DISCUSSION

Study of Anchorage snow disposal sites has provided local investigators with a detailed understanding of the processes by which the snowfill at these sites melts and mobilizes pollutants. The potential for manipulation of these processes is central to new management practices developed by MOA and leads to the basic conclusions of MOA’s 4-year study:

- Chloride can be controlled passively only through detention and dilution.
- Mobilization of metals and PAHs is related to chloride concentration, but a large fraction can be controlled with particulate capture.
- Particulate loading in meltwater is related to the geometry of the snowfill and the pad on which it is situated, and may be controlled by manipulation of these elements.

The first two principles have been examined in detail by other investigators (Novotny et al., 1999; Oberts et al., 2000) but the potential influence of site and snowfill geometry on pollutant release has not been significantly addressed. Observations at Anchorage suggest the melt processes that occur within and around a snowfill mass, along with the aspect, geometry and physical characteristics of the stored snow, play central roles in how the snowfill melts and the degree to which pollutants are mobilized during melting. MOA site investigators have identified three main stages in the melting of a snowfill: a) ripening, b) main melt and vertical deflation, and c) final melt and disintegration. These melt stages and their relation to pollutant mobilization are summarized below.

RIPENING: The Cold Snowfill Undergoes Internal Changes



Initial Snow Conditions		
Constituent	**Range**	**Median**
Water Equivalent	60%-72%	60%
Chloride	53-140 mg/L	115 mg/L
Total Sediment	0.6-14.6 kg/cu.m	3.25 kg/cu.m

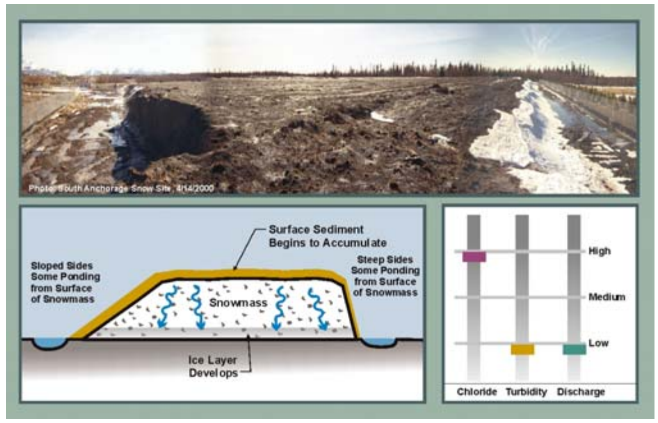
Snowfills hauled from Anchorage streets consist of lightly compacted snow and ice. These masses generally contain a homogenous, dilute distribution of fine mineral particles, and applied and fugitive chemicals. At conventional Anchorage snow disposal sites, heavy equipment operators place hauled snow onto earthen pads in a series of one or more lifts, each 2 to 4 meters thick. By the end of winter, the total mass of snow stored at any one of Anchorage's facilities is on the order of $7{\cdot}(10^4)$ cubic meters. Snowfills are steep-faced on several sides but often have one or more low-sloping faces where snow has been pushed into place. The albedo of a snowfill at the beginning of the melt period is typically high as a result of a covering of fallen snow and the snowfill's initial homogenous nature. Though no data has been collected at Anchorage snow disposal sites to confirm this, at the end of winter snowfills likely have low core temperatures relative to ambient spring conditions. Similar spring temperature gradients have been reported for much thinner natural snowpacks (Luce and Tarboton, 2001).

Radiant Energy Begins to Melt The Snowfill Surface

With the rapid rise in solar radiant heat, the top of snowfills begin to melt early in spring (March in Anchorage). However, water formed from this melt infiltrates and does not flow across the surface of the snowfills. 'Moulin'-like features, on the order of 3 to 5 cm across, are common and are thought to result from formation and rapid break-through of small puddles of meltwater at the surface. Also coring showed no continuous horizontal ice layers within snowfills (despite an Anchorage maintenance practice of watering tops of lifts to allow passage of winter truck traffic). As snow melts at the top of the snowfills during early ripening, movement of the meltwater appears to be generally vertical, with little apparent perching or lateral movement.

The Snowfill Ripens and A Basal Ice Layer Forms

The vertically infiltrating meltwater does not carry significant particulate matter with it. As a result, the albedo of a snowfill rapidly changes as snow and ice at the surface melts and infiltrates, leaving behind and concentrating in a thin layer the dark colored mineral particles present in the original hauled snow. Sampling at Anchorage sites shows that the infiltrating meltwater leaches chloride from the surface of ice crystals and solids within snowfills. However, despite a depressed freezing point, relict colder winter temperatures at the core of the snowfills refreeze the initial flow of infiltrating meltwater. Refreezing meltwater forms a thick ice layer, typically a little over a half a meter thick at the base of Anchorage snowfills. Though it is uncertain whether a progression of meltwater freeze and thaw fronts migrate downward or if larger ‘pulses’ of meltwater build the basal ice, the ice layer is commonly observed at the bottom of snowfills in Anchorage. During this stage little or no runoff escapes from the snowfill.

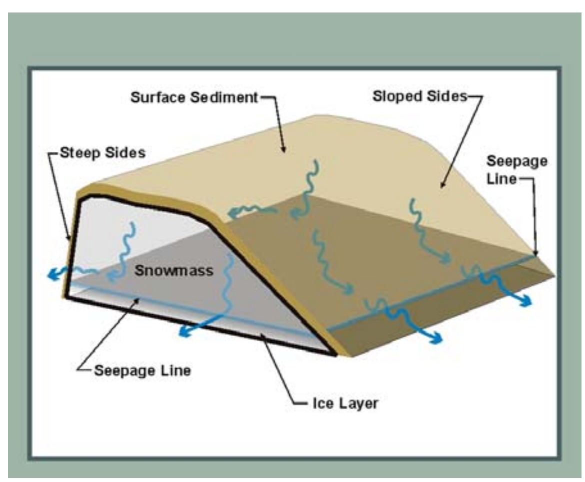


Snow cores and observations at Anchorage snow sites suggest the basal ice layers conform closely to the topography of the underlying ground surface for flat to moderately sloping pads. Sample cores and borings advanced in the snowfill at the V-swale site showed no significant increase in thickness of the basal ice layer, beyond normal variability, either laterally across the V-section or along the V-section trough. A generally uniform basal ice thickness independent of ground slope also seems reasonable, given that saturation and beginning of any lateral flow (that might support a localized increase in ice thickness) will not occur until the core snowfill temperatures have risen above those that will support refreezing and formation of basal ice.

MIDDLE MELT: MELTWATER FLOW FROM A SNOWFILL BEGINS

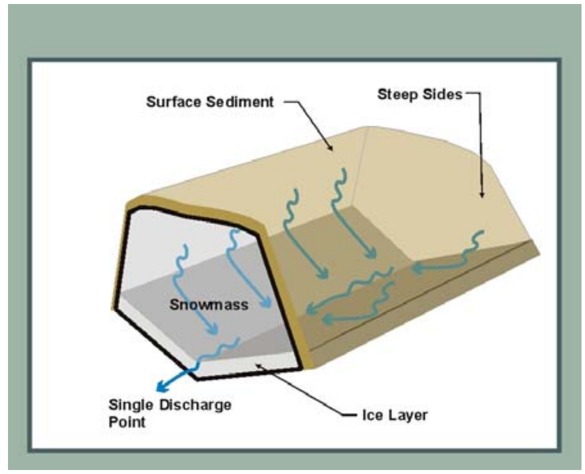
The middle stage of snowmelt occurs as meltwater begins to flow from a snowfill. Flow begins as soon as snowfill temperatures have equilibrated, the snow is saturated above the basal ice layer, and hydraulic head is sufficient to promote flow through the snowfill. The number and location of discharge points depends upon the quality of the snow and geometry of the pad on which it has been placed. Hydraulic head determined from measurements of saturated thickness in an Anchorage snowfill suggests a relatively low gradient (about 0.001 meters/meter) is required to move the meltwater through the snowfill during the early part of this stage. Others (Fox et al., 1997) report that tortuous, saturated flow in natural snowpacks is rapidly replaced by integrated flow along open conduits, but investigators observed no indication of this during the middle melt stage for snowfills placed on flat sites at Anchorage. However integrated flow along surface and subsurface conduits is an important process in later stages of melt for these sites.

For the experimental V-swale pad configuration, seepage at the pad perimeter was almost absent. Almost all meltwater discharge from the snowfill was confined to a single point at the downgradient end of the V-swale. Meltwater also exited the V-swale snowfill as an integrated flow—not as seepage—with this flow beginning at approximately the same time as more distributed seepages were first observed at adjacent, conventionally configured snowfills.



THE BASAL ICE CONTROLS SEEPAGE

During the middle meltwater stage, discharge observed at relatively flat, conventionally-configured Anchorage sites tends to occur as a continuous seepage along the top surface of the basal ice layer and around the entire perimeter of snowfills. Little or no early flow occurs under the basal ice, though pad geometry can work to encourage development of sub-basal ice meltwater conduits as the melt season progresses. At this stage, flows across the pad surface are directed along the perimeter of the basal ice (not under or through it). Though the seepages themselves have very low kinetic energy as they exit from the snowfill, erosive power as these flows integrate can become greatly enhanced by the configuration of both the snowfill and the pad on which it is placed.

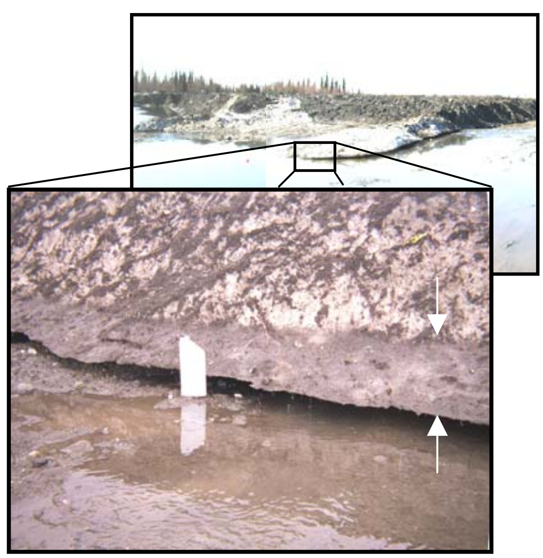


For meltwater discharge from the experimental V-swale, the flow exit point remained confined to the downslope end of the pad throughout this stage of the melt season. Concentrated internal flows along the axis of the V-swale tended to slowly erode the basal ice headward along the trough of the swale. As removal of the basal ice progressed up the trough, snow pad soils became exposed to erosion and are believed to have contributed to turbidity measured in meltwater at this site. However, exposed trough soils rapidly self-armored, limiting these effects.

Initial Pollutant Release Begins

Initial pollutant release begins with the first meltwater discharge from a snowfill. At Anchorage sites, because of early leaching and low meltwater volumes (3 to 5 liters/second [L/sec]), chloride concentrations from the initial discharge can be extremely high (10^3 to 10^4 milligrams per liter [mg/L]), dependent apparently upon deicing and snow hauling practices as they reflect year-to-year climate variability. At Anchorage, peak chloride releases wane within several weeks of first snowmelt discharge and fall rapidly as melting progresses. By the end of the middle stage of melt, flow is at a peak (10 to 30 L/sec) but chloride concentrations have typically fallen to concentrations of 10^2 mg/L or less.

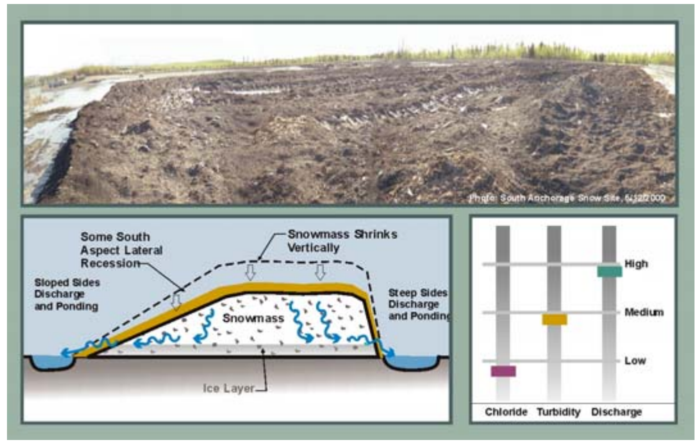
At this stage, particulates that have accumulated on snowfill or pad surfaces also become subject to erosion and transport by meltwater flow. As seepages exit from basal ice surfaces, they saturate the fine sediments accumulated on the surface of the snowfills. These sediments are then readily mobilized in gravity flows or entrained in meltwater as seepages become integrated. Mobilization of sediments on a snowfill surface is significantly greater where the snowfill is gently sloped. This is principally because a gently sloped surface represents a greater initial snowfill surface area and therefore exposes a larger pollutant load to erosion. On the other hand, near-vertical surfaces, besides representing smaller surface areas, tend to become self-armored as they build thick sediment accumulations away from the seepage face.



At Anchorage, where meltwater cascading from snowfills flowed across pad surfaces, turbidity was measured at 150 to over 1,000 nephelometric turbidity units (NTU), though a typical range was 350 to 500 NTU. Very shallow ponding (2 to 10 cm deep) occurring serendipitously on pad surfaces reduced the initial turbidity of meltwater accumulating on a pad to a range closer to 150 to 300 NTU. Throughout the early and middle stages of melt, flow discharging from the V-swale site showed notably lower turbidity values than all other locations, typically ranging from 10 to 50 NTU.

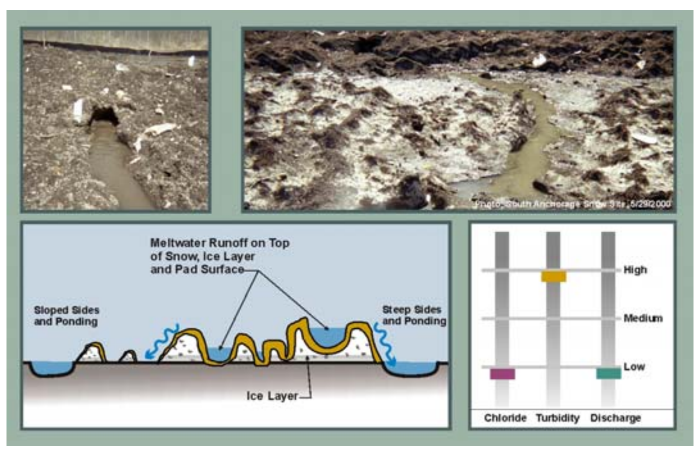
THE SNOWFILL SHRINKS VERTICALLY

As the middle melt stage progresses, a snowfill shrinks significantly in height over its entire area. Some perimeter recession also occurs, mostly along exposed south aspects and along strongly sloping faces. During this stage of vertical deflation, flow and ponding over the surface of a conventional snowfill still has not developed, and discharge occurs predominantly along the perimeter of the mass, initially as seepage at the edge of the basal ice and then as integrated flows across the pad surface. Conversely, flow from the experimental V-swale site remained confined principally to a single outlet point at the end of the V trough, with perimeter seepage and flow small compared to the trough discharge.



FINAL MELT: THE SNOWFILL DISINTEGRATES

In the beginning of the last stage of melt, a basal ice layer underlying a snowfill becomes exposed locally. At this point, the direction of meltwater flow from a snowfill becomes less influenced by the transmissive characteristics of the snow mass and subsurface conduits, and more influenced by the underlying ground topography as reflected in the surface of the basal ice layer. Sediment collapses onto the basal ice layer and becomes subject to erosion and mobilization by relatively high meltwater flows. The underlying ground surface may also become exposed to erosion as the basal ice is melted or eroded.



Though chloride concentrations are relatively low at this final stage of melt, the erosive power of the meltwater flows and the collapse of the accumulating surface sediment onto flow surfaces greatly increases potential for the mobilization of particulates. The increasing isolation of snowfill remnants raises the potential for erosion as flows from upgradient snowmelt sources are directed across increasingly bare pad surfaces and against sediment collapsing from downgradient snowfills. Thawing of the pad surface may also reduce the mechanical resistance of surface soils to erosion. This may be particularly true where the pad soils have been weakened by ice segregation during winter freezing and are not protected by vegetation. All in all, as the snowfill at a site disintegrates into isolated snow masses, the basal ice layer erodes, and the pad soils become exposed to flows, the potential for mobilization of particulate pollutants rises dramatically. At this point, concentrations of particulates in meltwater can remain markedly high until most of the remaining snowfill is gone and flows subside.

CONCLUSIONS

Observation of the melting process at Anchorage snow disposal sites suggests a number of control opportunities. Control opportunities can be generally grouped as they address chloride (and soluble pollutants), or particulates (and adsorbed pollutants).

CHLORIDE CONTROL

Chloride and other soluble pollutants are not readily treated by simple technologies. Passive (non-chemical) treatment of chloride is best addressed through: control of street treatment processes, dilution of early meltwater discharges, and application of snow disposal site location criteria. Analysis of Anchorage salt application practices suggests total chloride loading could be reduced by as much as 60% through use of heated sand sheds. Because of leaching, however, detention and dilution of early snowmelt remains a critical element in snow disposal site design and operations criteria. Dilution with shallow ground water has been shown to be a viable option in Anchorage, but implementation requires knowledge of area hydrogeology (Wheaton, et al., 1998a) and acceptance of some changes in the structure of local vegetation communities (Hansen, 2001). On the other hand design for dilution taking place wholly within surface detention basins must consider a wide year-to-year variability in peak chloride concentrations in meltwater. Four years of record in Anchorage show a range in peak seasonal chloride concentration of greater than an order of magnitude (from 10^3 to 10^4 mg/L). This variability appears to be a function of climate and not of application amount, with larger peaks associated with years having more numerous and larger snowfall events. In any event, given the necessity for dilution, the potential for impacts to other local resources from elevated chloride requires careful consideration be given to facility siting.

Performance Observations	Early Melt	Mid-Melt	Disintegration
No Practices			
Turbidity (NTU)	150-350	350-500	>1,000
Chloride (mg/L)	1,000-10,000	100-500	<100
Shallow Ponding			
Turbidity (NTU)	70-150	150-300	>500
V-Swale			
Turbidity (NTU)	10-50	10-50	<200

PARTICULATE CONTROL

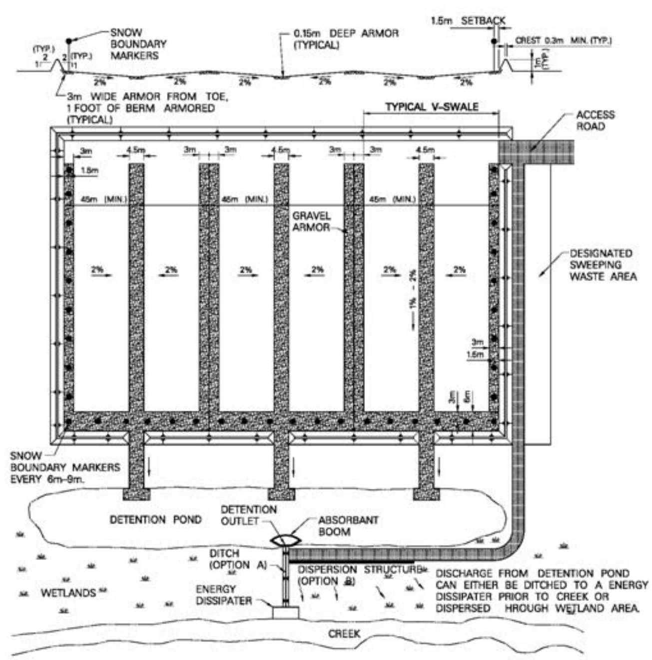
Where site selection to optimize opportunities for snowmelt dilution is critical in chloride control, designing and operating a snow disposal facility to take advantage of the inherently low energy environment of a melting snowfill is key in particulate control. Turbidity in snow disposal site flows is generated as meltwater exits and cascades off a snowfill, entraining sediment from the surface of the deflating mass. Turbidity may be further increased as meltwater crosses a pad surface, particularly if pad surface soils are unprotected, waste soils are exposed, or flow velocities are increased. Conversely, particulate matter is not significantly present in meltwater flowing in the saturated medium of the snowfill mass itself, as evidenced by turbidity that is an order of magnitude lower in flow from the experimental V-swale site than flow from conventional sites.

Anchorage observations suggest a number of simple options that may reduce turbidity by as much as 50% in snow disposal site meltwater. Perhaps the simplest option is changing practices to place snow in high, compact masses with steep sides all around to minimize the exposure of accumulating sediment on the snowfill surface to seepage and flow. Placing snowfill in a single mass rather than several isolated masses will also reduce exposure of sediment to upgradient meltwater sources. Sites can also be operated to take advantage of aspect, with snow placed as compact masses at northernmost downgradient locations so that a snowfill will preferentially recede from uphill to downhill. This practice will reduce exposure of downgradient sediment to meltwater flows as the sediment settles to the pad surface in the final stages of melt (and becomes most vulnerable to erosion). Placing snow to create shallow impoundments immediately against the melting snowfill may also be beneficial. Even very shallow impoundments can reduce pad erosion and turbidity by effectively ‘transporting’ meltwater over significant horizontal distances in a low-turbulence (pooled) environment. Use of setback staking and armored channels (oversized to provide room for icing) to direct and contain pad meltwater flows will also limit turbidity. Finally, off-season pad use should be restricted to minimize disturbance of pad soils and to allow re-vegetation.

Adjusting basic pad geometry, in conjunction with operational practices, promises even greater reductions in turbidity. The experimental V-swale pad tested at Anchorage may provide as much as an order of magnitude improvement in particulate control over more conventional (planar sloping) pad configurations. The V-swale configuration promotes meltwater movement as saturated flow within a snowfill so that particulates are not mobilized during the early and middle stages of melt. Flow directed along the trough of the V-swale ensures a single predictable discharge point so that flows can be further managed and directed to minimize erosion of pad and waste soils. The design also limits late-stage sediment mobilization by helping to short-circuit flows to armored channels. Note that because of variability in the thickness of the basal ice layer, controlled side slopes and swale widths are important to ensure that internal flows are directed to the swale trough. Based on observations of variability in basal ice thickness, MOA has established design parameters that are expected to successfully contain meltwater within the V-swale.

MOA Snow Disposal Site Design Criteria

Based on the results of its studies, MOA has developed a set of snow disposal site criteria for Anchorage. MOA criteria particularly emphasize an essential synergy between siting, design and operations. Though the criteria are specific to the typical scale of Anchorage snow storage facilities, they should be adaptable to other northern latitude communities as well. The criteria are generalized here—full text of the recommended criteria can be obtained from MOA upon request.



MULTIPLE V–SWALE SNOW SITE DESIGN CONCEPT

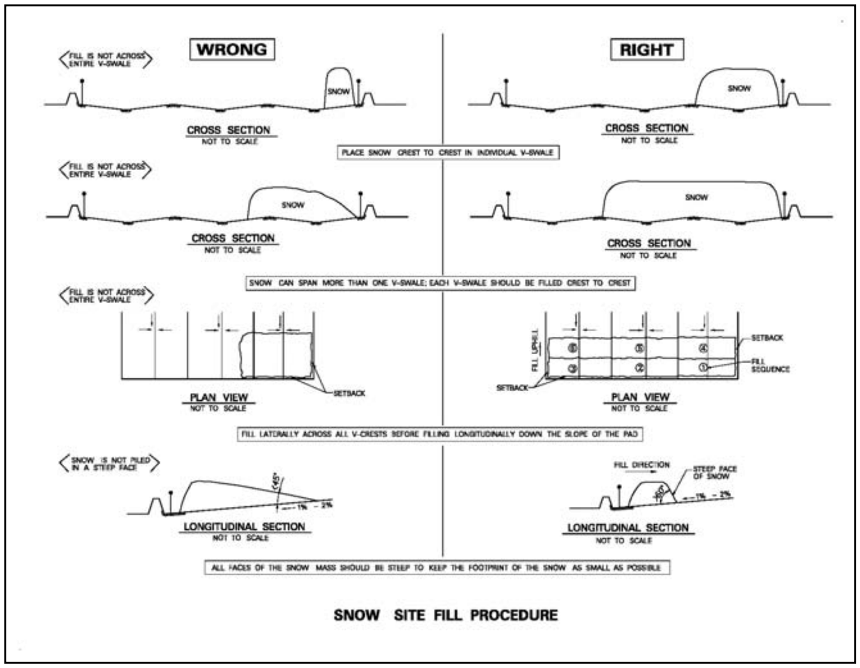
Siting Criteria

- Avoid meltwater discharge to potable water aquifers.
- Avoid meltwater discharge to ‘closed’ lakes and wetlands.
- Avoid reduction of functionality of receiving wetlands.
- Avoid meltwater discharge to streams having winter base flows less than 85 L/sec.
- Optimize opportunities for infiltration to shallow non-potable ground water systems.
- Optimize opportunities for a site orientation sloping down from south to north.

Design Criteria

- Map local and site hydrogeology within 300-meter (m) of site.
- Construct pad with a single or multiple V-swale configuration (minimum 45m crest-to-crest swale width, 2% side slope to central trough, and 1-2% longitudinal slope).

- Orient V-swale longitudinal axes downhill from south to north.
- Establish and flag setbacks from swale crests and facility perimeter.
- Armor swale troughs and crests and all facility drainage channels and containment berms.
- ‘Trackwalk’ (imprint with crawler tractor treads trafficking directly upslope and downslope) and vegetate all non-armored pad surfaces with a mix resistant to an annual 2-5cm sediment burial.
- Construct dry detention ponds or other treatment to control chloride and sediment releases (mean chloride release per: 1day=<3600mg/L, 30day=<1200mg/L, and season=<300mg/L; sediment removal at $\geq$95% of +100μm particles).
- Install flow dispersion and energy dissipation controls at all outfalls to receiving waters.



SNOW SITE FILL PROCEDURE

OPERATIONAL CRITERIA

- Place hauled snow over the full width of each V-swale.
- Sequence placement of snow starting at the downslope side and working upslope.
- Maintain snow in a compact mass with steep sides (1h:1½v or steeper).
- Maintain setback from all containment berms and from the discharge end of V-swales.
- Maintain pad vegetative cover and re-grade only to ensure V-swale functionality.
- Restrict access and prohibit off-season traffic and non-snow storage uses.

References

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Watershed Management Services (WMS), 1999a. Anchorage Street Deicer and Snow Disposal 1999 Best Management Practices Guidance, Document No. WMP CPg99002. MOA WMS, p. 34 and Attachments, December.

WMS, 1999b, Meltwater Runoff from Anchorage Streets and Snow Disposal: 1999 Data Report, Document No. WMP APr99003 MOA WMS, p. 31 and Attachments, December.

WMS, 2000a, Anchorage Street Deicer and Snow Disposal Investigation: 2000 Data Report, Document No. WMP Apr00004. MOA WMS, p. 34 and Attachments, November

WMS, 2000b, Anchorage Street Deicer and Snow Disposal Investigation: 2000 Best Management Practices Guidance, Document No. WMP CPg00003. MOA WMS, p. 34 and Attachments, November.

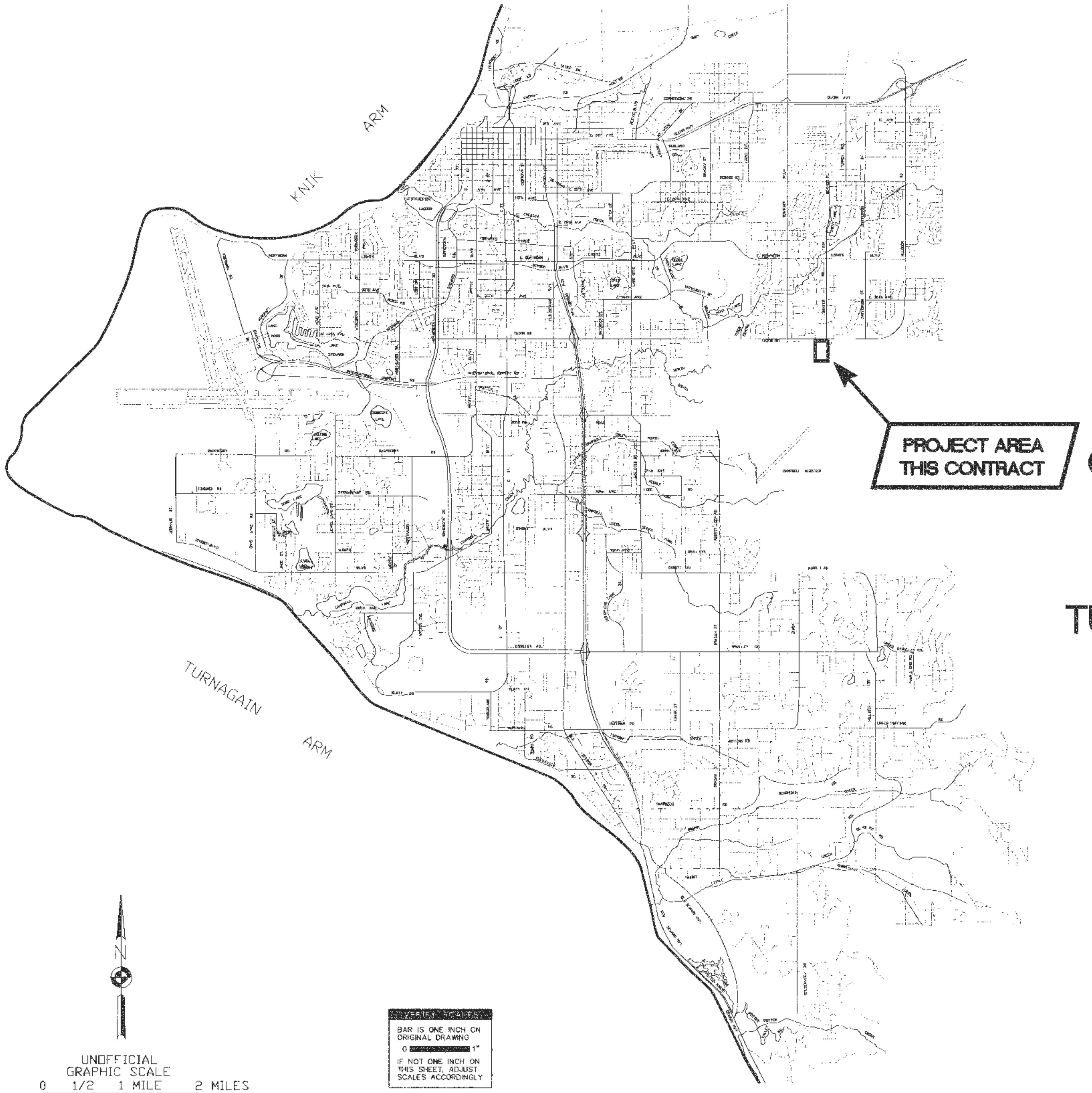
ANCHORAGE SNOW DISPOSAL SITES:
2013 EVALUATION

Document No.: WMP ARr14002
WMS Project No.: 95004

Appendix B – V-Swale Site Design Sheets

Contents:

1. Tudor Snow Disposal Site
2. Spruce Street Snow Disposal Site



ANCHORAGE ALASKA

MUNICIPALITY OF ANCHORAGE
OFFICE OF PLANNING, DEVELOPMENT AND PUBLIC WORKS

TUDOR ROAD/CAMPBELL AIRSTRIP ROAD AREA SNOW DISPOSAL SITE WATER QUALITY UPGRADE
Project 01-21

APPROVED BY:

MARK BEGICH
MAYOR

HOWARD C. HOLTAN P.E., L.S.
MUNICIPAL ENGINEER

FILE NO. 04-1146

ABBREVIATIONS

ADOT/PF	STATE OF ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
B.O.P.	BEGINNING OF PROJECT / BOTTOM OF PIPE
BM	BENCH MARK
C & G	CURB & GUTTER
℄	CENTERLINE
C.A.R.	CAMPBELL AIRSTRIP ROAD
CONST.	CONSTRUCT
DTL	DETAIL
E.O.P.	END OF PROJECT
EP	EDGE OF PAVEMENT
ELEV	ELEVATION
EL	EASEMENT LINE
EST.	ESTIMATED
EXIST	EXISTING
F & I	FURNISH AND INSTALL
F.G.	FINISHED GRADE
FL	FLOW LINE
I.A.W.	IN ACCORDANCE WITH
INV.	INVERT
LOC	LOCATION
LT.	LEFT
M.A.S.S.	MUNICIPALITY OF ANCHORAGE STANDARD SPECIFICATIONS, STREETS–DRAINAGE–UTILITIES–PARKS, 1994 AS CURRENTLY AMENDED
MAX.	MAXIMUM
M.E.	MATCH EXISTING
M.H.	MANHOLE
MIN.	MINIMUM
MON	MONUMENT
MSL	MEAN SEA LEVEL
NTS	NOT TO SCALE
NWT	NO WATER TABLE
O.C.	ON CENTER
OGS	OIL/GREASE SEPARATOR
P.C.C.	PORTLAND CEMENT CONCRETE
PL	PROPERTY LINE
PC	POINT OF CURVATURE
PT	POINT OF TANGENCY
PVC	POINT OF VERTICAL CURVATURE
PVI	POINT OF VERTICAL INTERSECTION
PVT	POINT OF VERTICAL TANGENCY
P.U.E.	PUBLIC USE EASEMENT
R	RADIUS
R & R	REMOVE AND REPLACE / RELOCATE / RE-SET
R.O.W.	RIGHT-OF-WAY
RT.	RIGHT
S.I.	STREET INTERSECTION
S.P.	SPECIAL PROVISION
SS	SANITARY SEWER
STA	STATION
STD. DTL.	STANDARD DETAIL FOUND IN M.A.S.S. 1994
ST	STREET
STR	STRUCTURE
S/W	SIDEWALK
TBC	TOP BACK OF CURB
TBM	TEMPORARY BENCH MARK
(30')	DIMENSION FROM RECORD DRAWINGS
(symbol)	DETAIL AND SHEET NUMBER FOR DETAIL
(50)	PROPOSED SURVEY POINTS

LEGEND

PLAN

EXISTING / PROPOSED

- EASEMENT LINE
- CENTERLINE
- CONSTRUCTION CENTERLINE
- PROPERTY LINE
- TEMPORARY CONSTRUCTION PERMIT
- GRAVEL ROADWAY OR DRIVEWAY
- LIMITS OF CUT SLOPE
- LIMITS OF FILL SLOPE
- X — FENCE
- E — UNDERGROUND ELECTRIC LINE
- FO — UNDERGROUND FIBER OPTIC LINE
- G — UNDERGROUND GAS LINE
- S — UNDERGROUND SANITARY SEWER LINE
- SD — UNDERGROUND STORM DRAIN OR SUBDRAIN LINE
- T — UNDERGROUND TELEPHONE LINE
- TV — UNDERGROUND TELEVISION LINE
- TR — UNDERGROUND TRAFFIC LINE
- W — UNDERGROUND WATER LINE
- OE — ELECTRIC LINE (OVERHEAD)
- OT — TELEPHONE LINE (OVERHEAD)
- SMALL ELECTRICAL/ TELEPHONE MANHOLE
- LARGE ELECTRICAL/ TELEPHONE MANHOLE
- JUNCTION BOX (TRAFFIC)
- CABLE TV JUNCTION BOX
- TREE C (Conifer)
- TREE D (Deciduous)
- G.M. — GAS METER
- U.E. — UNDERGROUND ELECTRIC PEDESTAL
- U.T. — UNDERGROUND TELEPHONE PEDESTAL
- M.B. — MAILBOX
- BRASS CAP MONUMENT
- ALUMINUM CAP MONUMENT
- I.P. — IRON PIN OR REBAR
- TEMP. BENCH MARK
- GAS VALVE
- EM — ELECTRIC METER
- GUY ANCHOR
- G.P. — GUY POLE
- L.P. — LIGHT POLE
- P.P. — POWER POLE
- T.P. — TELEPHONE POLE
- LIGHT POLE
- TRAFFIC SIGNAL POLE
- LIGHT POLE WITH JUNCTION BOX
- FIRE HYDRANT
- STREET SIGNS
- STORM DRAIN MANHOLE
- CATCH BASIN
- SANITARY SEWER MANHOLE
- STORM DRAIN CATCH BASIN MANHOLE
- C.O. — SANITARY SEWER CLEANOUT
- (SIZE) — SEWER SERVICE CONNECT
- DRYWELL
- KEY BOX/WATER VALVE
- CULVERT
- CURB AND GUTTER
- DITCH
- BUILDING
- 25 — RADIUS TO TOP BACK OF CURB
- DRAINAGE ARROW
- GRAVEL ARMOR

GENERAL NOTES

1. CONSTRUCTION SHALL BE COMPLETED IN ACCORDANCE WITH THE MOST CURRENT EDITION OF THE MUNICIPALITY OF ANCHORAGE STANDARD SPECIFICATIONS, STREETS–DRAINAGE–UTILITIES–PARKS, HEREAFTER REFERRED TO AS M.A.S.S., AS CURRENTLY AMENDED BY THE SPECIAL PROVISIONS.
2. CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS PRIOR TO BEGINNING CONSTRUCTION. THE PERMITS SHALL BE MAINTAINED AT THE JOB SITE.
3. CONTRACTOR SHALL MAINTAIN "REDLINE" RECORD DRAWINGS ON A CLEAN SET OF CONSTRUCTION DRAWINGS IN ACCORDANCE WITH M.A.S.S. DIVISION 65.00 CONSTRUCTION SPECIFICATIONS FOR CONSTRUCTION SURVEY. THE "REDLINES" SHALL BE KEPT CURRENT ON A DAILY BASIS AND SHALL BE AVAILABLE TO THE ENGINEER FOR INSPECTION ON THE JOBSITE. CONTRACTOR SHALL RECORD SURVEY NOTES AND SUBMIT DAILY TO THE ENGINEER.
4. CONTRACTOR SHALL RECORD SURVEY NOTES FOR SUBMITTAL WITH AS-BUILT PLANS, INCLUDING HORIZONTAL AND VERTICAL LOCATIONS OF ALL UTILITIES ENCOUNTERED IN THE FIELD. CONTRACTOR SHALL RECORD ALL DEVIATIONS FROM THE PLANS.
5. ALL CONSTRUCTION OPERATIONS REQUIRED FOR THIS PROJECT SHALL REMAIN WITHIN EXISTING M.O.A. PROPERTY, RIGHTS-OF-WAY AND EASEMENTS, UNLESS OTHERWISE APPROVED IN WRITING BY THE ENGINEER AND THE AFFECTED PROPERTY OWNER.
6. UTILITY RELOCATES SHALL BE DONE BY OTHERS, UNLESS OTHERWISE NOTED.
7. EXACT LOCATION OF EXCAVATION AND BACKFILL SHALL BE AS SHOWN ON THE PLANS OR AS DIRECTED BY THE ENGINEER.
8. CONTRACTOR SHALL RESTORE DISTURBED PROPERTY TO PRECONSTRUCTION CONDITION(S), UNLESS OTHERWISE DIRECTED BY THE ENGINEER. PAYMENT FOR RESTORING DISTURBED PROPERTY SHALL BE CONSIDERED INCIDENTAL TO THE PROJECT AND AND NO SEPARATE PAYMENT SHALL BE MADE, UNLESS BID ITEMS ARE PROVIDED.
9. SEED ALL AREAS DISTURBED AND NOT OTHERWISE IMPROVED. IMPROVED AREAS NOT SEEDED SHALL INCLUDE, BUT NOT BE LIMITED TO THE WEIRS, ACCESS ROADS, VEHICLE STORAGE AREA, AND ARMORED AREAS.

PROFILE

EXISTING / PROPOSED

- ℄
- NORTH OR WEST PROPERTY LINE
- SOUTH OR EAST PROPERTY LINE
- PIPE
- MANHOLE (PAVING PROFILE ONLY)
- (PAVING PROFILE ONLY)
- 0.00% — CATCH BASIN OR CATCH BASIN MANHOLE GRADE AT ℄ OF PAVEMENT
- SANITARY SEWER LINE AND MANHOLE
- 0.0% 0.0% — STORM DRAIN OR SUBDRAIN LINE AND MANHOLE

GW	WELL GRADED GRAVEL
GP	POORLY GRADED GRAVEL
GM	SILTY GRAVEL
GC	CLAYEY GRAVEL
SW	WELL GRADED SAND
SP	POORLY GRADED SAND
SM	SILTY SAND
SC	CLAYEY SAND

LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILT
	CL	INORGANIC CLAY
	OL	ORGANIC SILT
LIQUID LIMIT GREATER THAN 50	MH	INORGANIC SILT
	CH	INORGANIC CLAY
	OH	ORGANIC CLAY
	PT	PEAT

- % PASSING 200
- WATER LEVEL
- TEST HOLE LOCATION

CALL BEFORE YOU DIG

THE CONTRACTOR SHALL NOTIFY ALL AREA UTILITY COMPANIES PRIOR TO COMMENCEMENT OF EXCAVATION. THE FOLLOWING IS A PARTIAL LIST:

LOCATE CALL CENTER OF ALASKA 278–3121
(INCLUDES ACS, AWWU, CEA, ENG, BUTLER AVIATION/TESORO, GCI CABLE, MLP, TRAFFIC SIGNALS, MOA STORM/STREETS, AND ALASKA FIBER STAR.)

STATE STORM/STREET LIGHTS 333–2411
MILITARY PETROLEUM LINES 862–4112

SHEET	DRAWING
1.	TITLE SHEET
2.	KEY MAP AND LEGEND
3.	SURVEY CONTROL DIAGRAM
4.	GRADING PLAN
5.	GRADING PLAN
6.	ROADWAY PLAN AND PROFILE (CAMPBELL AIRSTRIP ENTRY ROAD)
7.	ROADWAY PLAN AND PROFILE (TUDOR ENTRY ROAD)
8.	DETAILS
9.	ELECTRICAL SYMBOLS AND DETAILS
10.	ELECTRICAL PLAN AND DETAILS

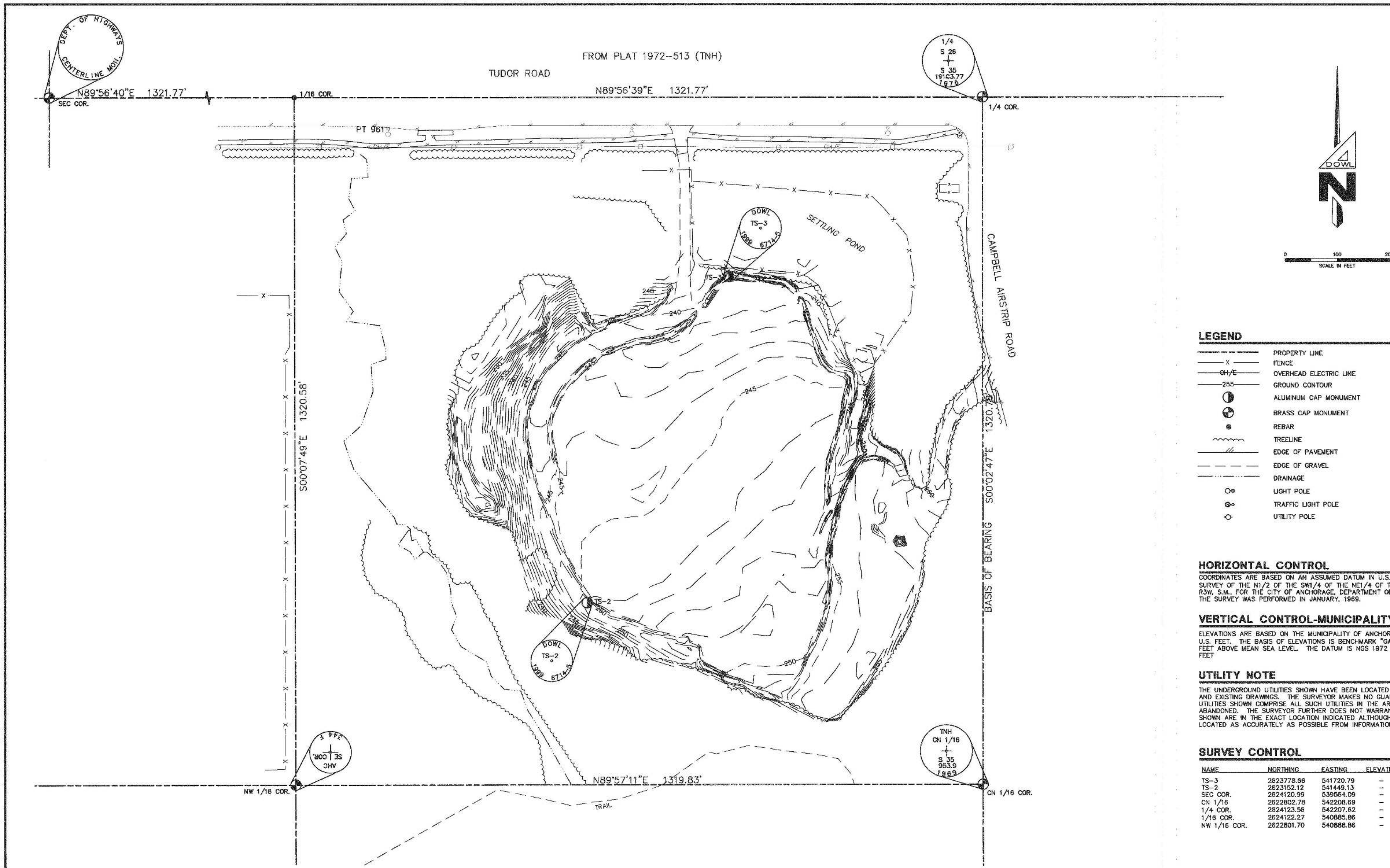
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

01–21 TUDOR ROAD/CAMPBELL AIRSTRIP ROAD AREA SNOW DISPOSAL SITE WATER QUALITY UPGRADE SCHEDULE A&B

KEY MAP AND LEGEND

SCALE: NO SCALE | DATE: 7/15/2004 | GRID: 1838 | ACCT. NO. | SHEET 2 of 10

FILE NO.04–1147



LEGEND

- PROPERTY LINE
- FENCE
- OVERHEAD ELECTRIC LINE
- GROUND CONTOUR
- ALUMINUM CAP MONUMENT
- BRASS CAP MONUMENT
- REBAR
- TREELINE
- EDGE OF PAVEMENT
- EDGE OF GRAVEL
- DRAINAGE
- LIGHT POLE
- TRAFFIC LIGHT POLE
- UTILITY POLE

HORIZONTAL CONTROL

COORDINATES ARE BASED ON AN ASSUMED DATUM IN U.S. FEET. BEARINGS ARE BASED ON A SURVEY OF THE N1/2 OF THE SW1/4 OF THE NE1/4 OF THE NE1/4 OF SECTION 35, T13N, R3W, S.M., FOR THE CITY OF ANCHORAGE, DEPARTMENT OF PUBLIC WORKS, WATER DIVISION. THE SURVEY WAS PERFORMED IN JANUARY, 1969.

VERTICAL CONTROL-MUNICIPALITY OF ANCHORAGE

ELEVATIONS ARE BASED ON THE MUNICIPALITY OF ANCHORAGE VERTICAL CONTROL NETWORK IN U.S. FEET. THE BASIS OF ELEVATIONS IS BENCHMARK "GAAB-66" HAVING A VALUE OF 238.10 FEET ABOVE MEAN SEA LEVEL. THE DATUM IS NGS 1972 ADJUST, MEAN SEA LEVEL = 0.00 FEET

UTILITY NOTE

THE UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING DRAWINGS. THE SURVEYOR MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH HE DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM INFORMATION AVAILABLE.

SURVEY CONTROL

NAME	NORTHING	EASTING	ELEVATION	DESCRIPTION
TS-3	2623778.66	541720.79	–	ALCAP
TS-2	2623152.12	541449.13	–	ALCAP
SEC COR.	2624120.99	539564.09	–	BRASS CAP
CN 1/16	2622802.78	542208.69	–	BRASS CAP
1/4 COR.	2624123.56	542207.62	–	BRASS CAP
1/16 COR.	2624122.27	540885.86	–	REBAR
NW 1/16 COR.	2622801.70	540888.86	–	BRASS CAP

FIELD BOOKS	BM NO.	LOCATION	ELEV.	DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
DESIGN: 3210	GAAB-66		238.10	BASE			TELEPHONE		
				TOPOGRAPHY			ELECTRIC		
STAKING:				PROFILE			CABLE TV		
				SANITARY SEWER			TRAFFIC SIGNAL		
ASBUILT:				STORM SEWER			DESIGN		
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM			WATER			QUANTITIES		
INSPECTOR:				GAS			MUN. FINAL CHECK		
CONSTRUCTION RECORD	VERTICAL DATUM			PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
REVISIONS							

SEAL

STATE OF ALASKA 49TH Stanley E. Ponsness LS-6714 8/16/04 REGISTERED PROFESSIONAL LAND SURVEYOR

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

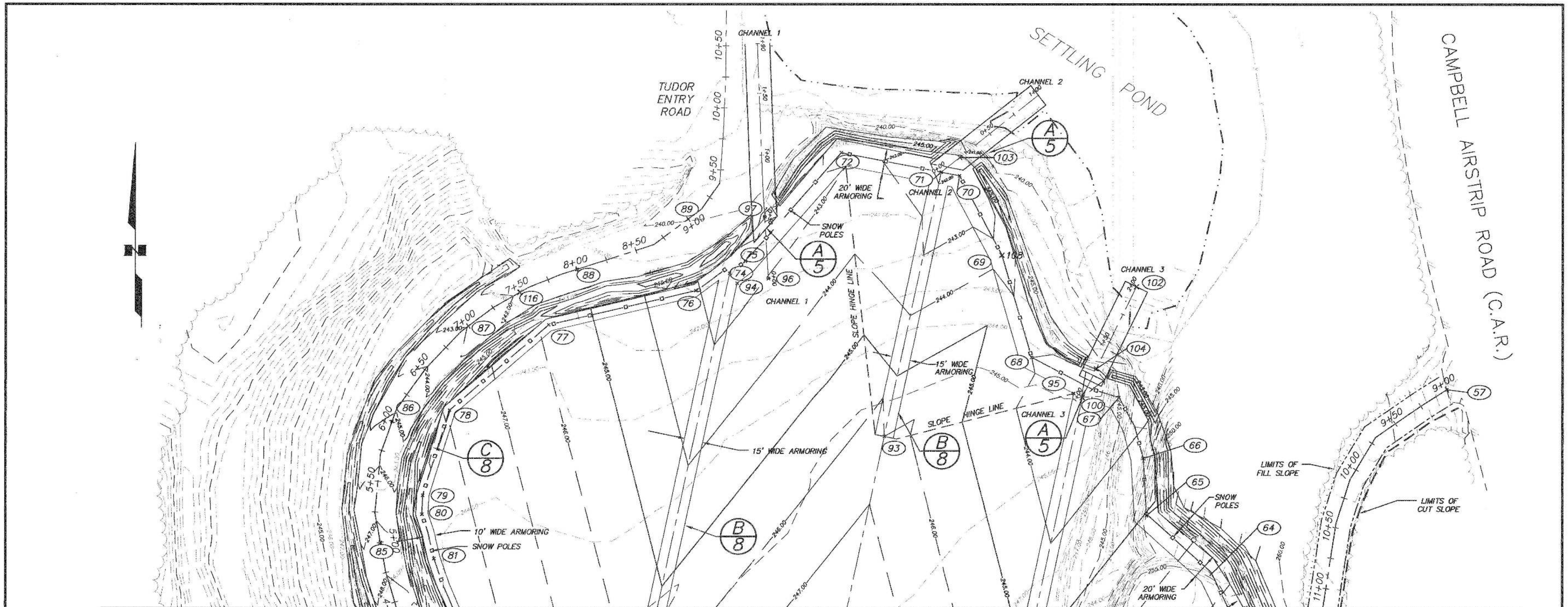
01-21 SCHEDULE A

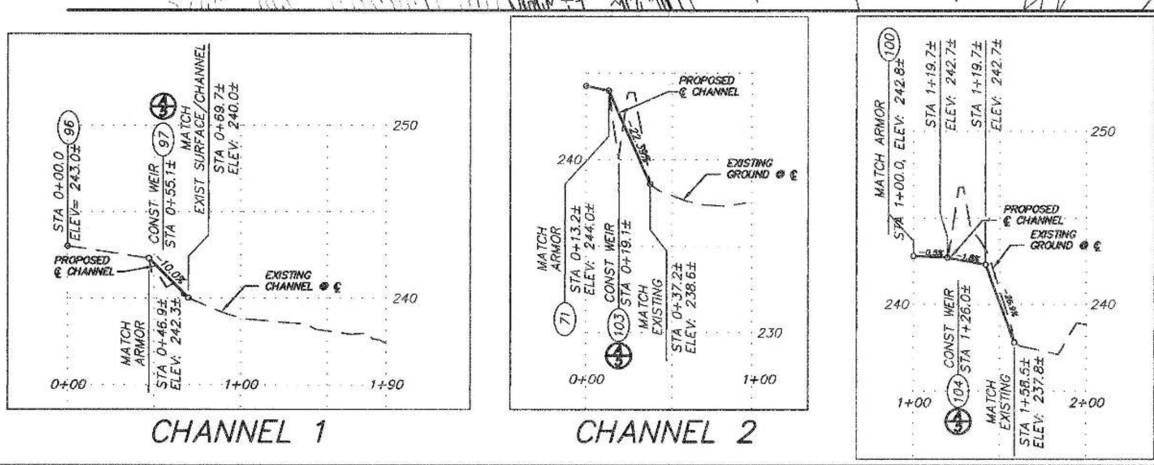
TUDOR ROAD/CAMPBELL AIRSTRIP ROAD
AREA SNOW DISPOSAL SITE WATER QUALITY UPGRADE

SURVEY CONTROL

SCALE: 1"=100' | DATE: 10/9/2003 | GRID 1838 | ACCT. NO. | SHEET 3 of 10

FILE NO. 04-1149





CHANNEL SCALES : HORIZ 1"=50'
: VERT 1"=5'

GRADING NOTES:

1. ADJUST FINAL BERM TERMINI/LOCATION TO MATCH WEIR I.A.W. (A/5)
2. WEIRS SHALL ALIGN WITH BERMS; FINAL LOCATION SHALL BE APPROVED BY THE ENGINEER.
3. CENTER SNOW POLES WITHIN ARMORING, SPACED AT 30.0' ON CENTER.
4. INSTALL SNOW POLES ON C.A.R. ENTRY ROAD SHOULDER FROM STA 11+50 TO 14+00, SPACED 50' ON CENTER.
5. PLACE EROSION CONTROL BLANKET ON CUT-SLOPE BETWEEN STATIONS 11+50.0 AND 14+00.0, OR AS DIRECTED BY THE ENGINEER.
6. PLACE GEOTEXTILE (SEPARATION) ON EXPOSED SURFACE OF BERM AS SHOWN, OR AS DIRECTED BY THE ENGINEER. COVER GEOTEXTILE WITH RIP-RAP (CLASS 1), 1.0' DEEP.
7. PLACE RIP-RAP (CLASS 1) ACROSS FRONT AND BACK OF WEIR, 6'X3'X0.5', OR AS DIRECTED BY THE ENGINEER.
8. INSTALL SILT FENCE ALONG NORTH EDGE OF EXISTING BERM I.A.W. DETAIL (D/8) OR AS DIRECTED BY THE ENGINEER. (BETWEEN POINTS (67) AND (76))

FIELD BOOKS		BM NO.	LOCATION	ELEV.
DESIGN:	NUMBERS	GAAB-66	–	238.10
STAKING:				
ASBUILT:				
CONTRACTOR:		BASIS OF DATUM:	1972 N.G.S. DATUM	
INSPECTOR:				
CONSTRUCTION RECORD		VERTICAL DATUM		

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	–	–	TELEPHONE	–	–
TOPOGRAPHY	–	–	ELECTRIC	–	–
PROFILE	–	–	CABLE TV	–	–
SANITARY SEWER	–	–	DESIGN	MJM	JLG
STORM SEWER	–	–	QUANTITIES	JLG	–
WATER	–	–	MUN. FINAL CHECK		
GAS	–	–			
PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY

REVISIONS

SEAL

STATE OF ALASKA — 49th — STEPHEN D. SHRADER No. CE 4148 — REGISTERED PROFESSIONAL ENGINEER

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

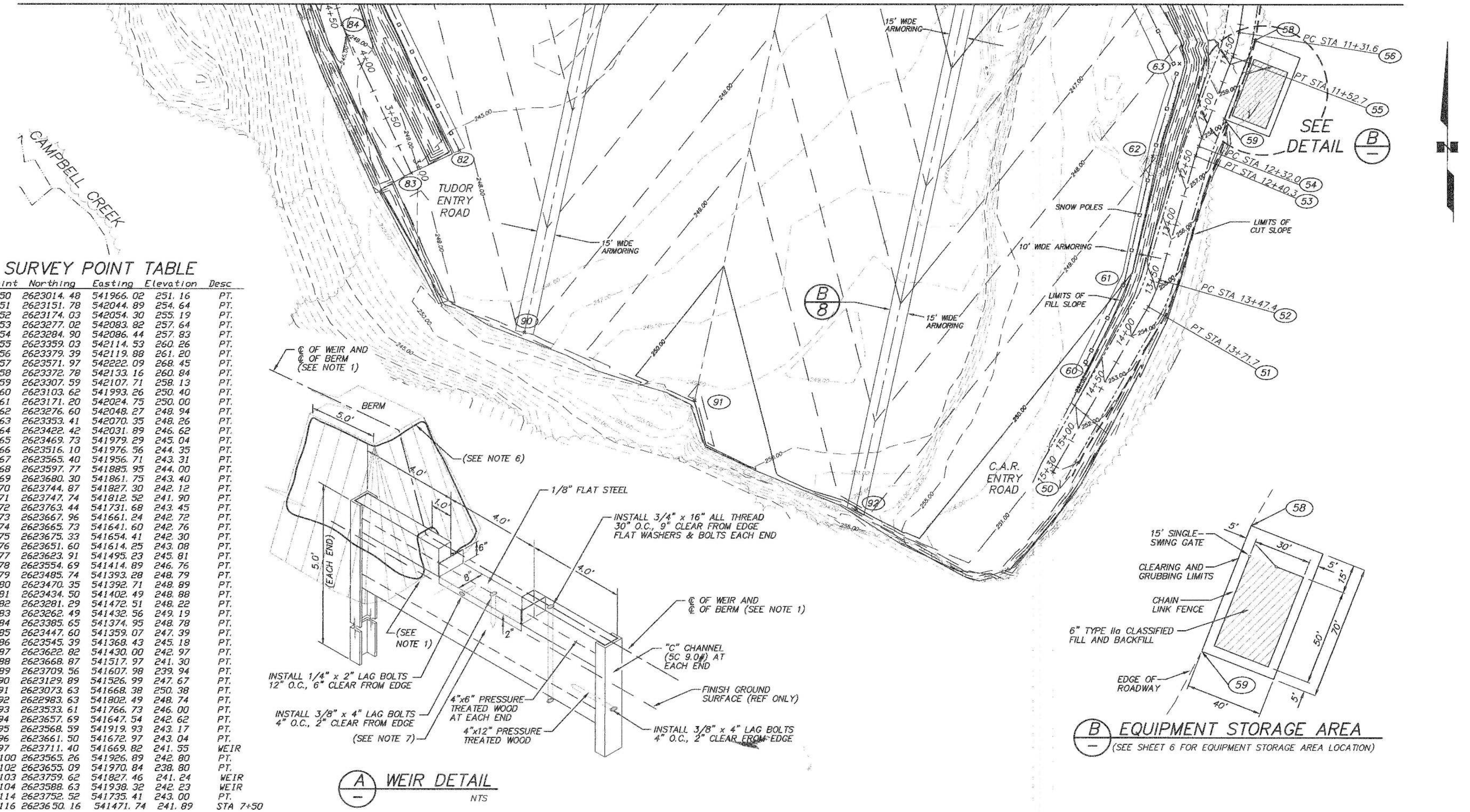
01-21 TUDOR ROAD/CAMPBELL AIRSTRIP ROAD AREA SNOW DISPOSAL SITE WATER QUALITY UPGRADE — SCHEDULE A

GRADING PLAN

SCALE: 1"=40' | DATE: 7/15/2004 | GRID: 1838 | ACCT. NO. | SHEET 4 of 10

FILE NO. 04-1149

MATCHLINE SEE SHEET 4



A WEIR DETAIL
NTS

B EQUIPMENT STORAGE AREA
(SEE SHEET 6 FOR EQUIPMENT STORAGE AREA LOCATION)

SURVEY POINT TABLE

Point	Northing	Easting	Elevation	Desc
50	2623014. 48	541966. 02	251. 16	PT.
51	2623151. 78	542044. 89	254. 64	PT.
52	2623174. 03	542054. 30	255. 19	PT.
53	2623277. 02	542083. 82	257. 64	PT.
54	2623284. 90	542086. 44	257. 83	PT.
55	2623359. 03	542114. 53	260. 26	PT.
56	2623379. 39	542119. 88	261. 20	PT.
57	2623571. 97	542222. 09	268. 45	PT.
58	2623372. 78	542133. 16	260. 84	PT.
59	2623307. 59	542107. 71	258. 13	PT.
60	2623103. 62	541993. 26	250. 40	PT.
61	2623171. 20	542024. 75	250. 00	PT.
62	2623276. 60	542048. 27	248. 94	PT.
63	2623353. 41	542070. 35	248. 26	PT.
64	2623422. 42	542031. 89	246. 62	PT.
65	2623469. 73	541979. 29	245. 04	PT.
66	2623516. 10	541976. 56	244. 35	PT.
67	2623565. 40	541956. 71	243. 31	PT.
68	2623597. 77	541885. 95	244. 00	PT.
69	2623680. 30	541861. 75	243. 40	PT.
70	2623744. 87	541827. 30	242. 12	PT.
71	2623747. 74	541812. 52	241. 90	PT.
72	2623763. 44	541731. 68	243. 45	PT.
73	2623667. 96	541661. 24	242. 72	PT.
74	2623665. 73	541641. 60	242. 76	PT.
75	2623675. 33	541654. 41	242. 30	PT.
76	2623651. 60	541614. 25	243. 08	PT.
77	2623623. 91	541495. 23	245. 81	PT.
78	2623554. 69	541414. 89	246. 76	PT.
79	2623485. 74	541393. 28	248. 79	PT.
80	2623470. 35	541392. 71	248. 89	PT.
81	2623434. 50	541402. 49	248. 88	PT.
82	2623281. 29	541472. 51	248. 22	PT.
83	2623262. 49	541432. 56	249. 19	PT.
84	2623385. 65	541374. 95	248. 78	PT.
85	2623447. 60	541359. 07	247. 39	PT.
86	2623545. 39	541368. 43	245. 18	PT.
87	2623622. 82	541430. 00	242. 97	PT.
88	2623668. 87	541517. 97	241. 30	PT.
89	2623709. 56	541607. 98	239. 94	PT.
90	2623129. 89	541526. 99	247. 67	PT.
91	2623073. 63	541668. 38	250. 38	PT.
92	2622983. 63	541802. 49	248. 74	PT.
93	2623533. 61	541766. 73	246. 00	PT.
94	2623657. 69	541647. 54	242. 62	PT.
95	2623568. 59	541919. 93	243. 17	PT.
96	2623661. 50	541672. 97	243. 04	PT.
97	2623711. 40	541669. 82	241. 55	WEIR
100	2623565. 26	541926. 89	242. 80	PT.
102	2623655. 09	541970. 84	238. 80	PT.
103	2623759. 62	541827. 46	241. 24	WEIR
104	2623588. 63	541938. 32	242. 23	WEIR
114	2623752. 52	541735. 41	243. 00	PT.
116	2623650. 16	541471. 74	241. 89	STA 7+50

FIELD BOOKS	BM NO.	LOCATION	ELEV.
DESIGN: NUMBERS	GAAB-66	–	238.10
	TS-2		250.78
STAKING:	TS-3		244.34
ASBUILT:			
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. DATUM		
INSPECTOR:			
CONSTRUCTION RECORD	VERTICAL DATUM		

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	–	–	TELEPHONE	–	–
TOPOGRAPHY	–	–	ELECTRIC	–	–
PROFILE	–	–	CABLE TV	–	–
SANITARY SEWER	–	–	DESIGN	MJM	JLG
STORM SEWER	–	–	QUANTITIES	JLG	–
WATER	–	–	MUN. FINAL CHECK		
GAS	–	–			

PLAN CHECK

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY

REVISIONS

SEAL

SEAL: STATE OF ALASKA 49th STEPHEN D. SHRADER No. CE 4148 REGISTERED PROFESSIONAL ENGINEER

MUNICIPALITY OF ANCHORAGE

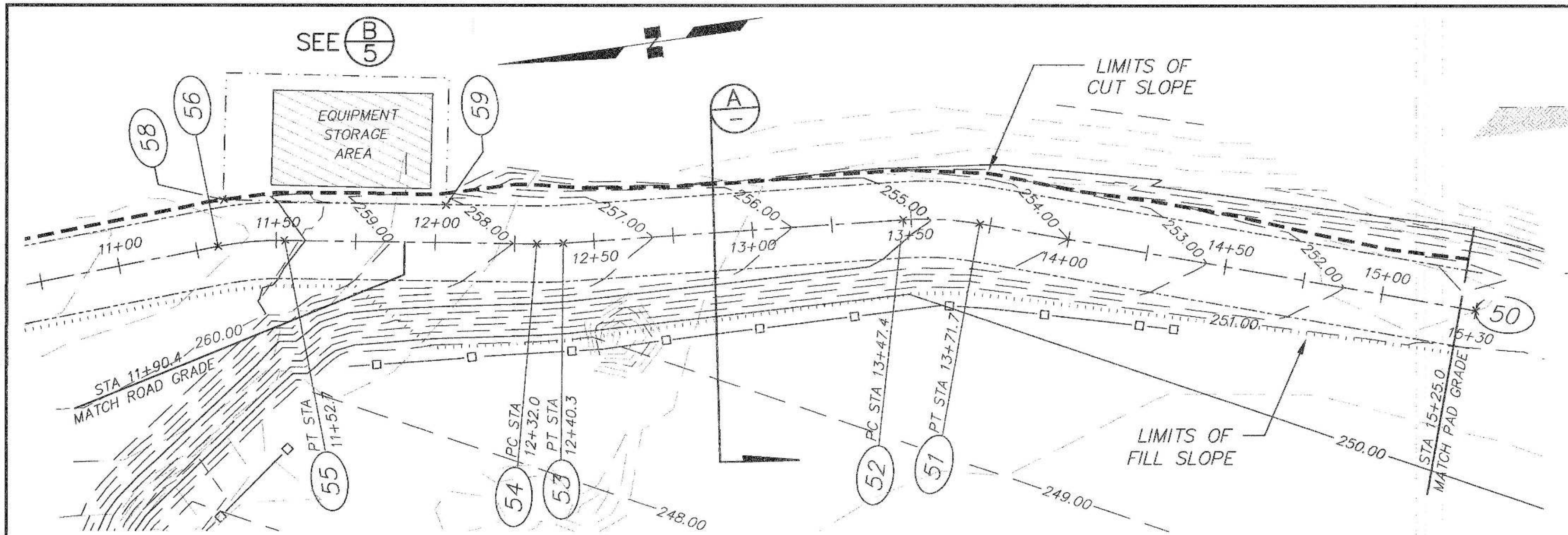
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

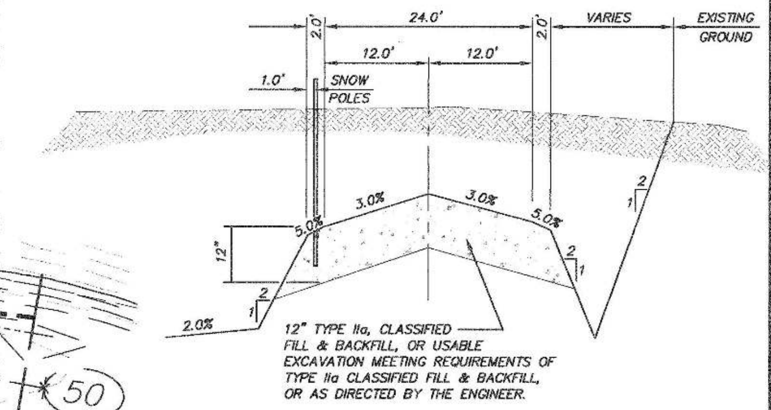
01-21 TUDOR ROAD/CAMPBELL AIRSTRIP ROAD AREA SNOW DISPOSAL SITE WATER QUALITY UPGRADE SCHEDULE A

GRADING PLAN

SCALE: 1"=40' | DATE: 7/15/2004 | GRID: 1838 | ACCT. NO. | SHEET 5 of 10

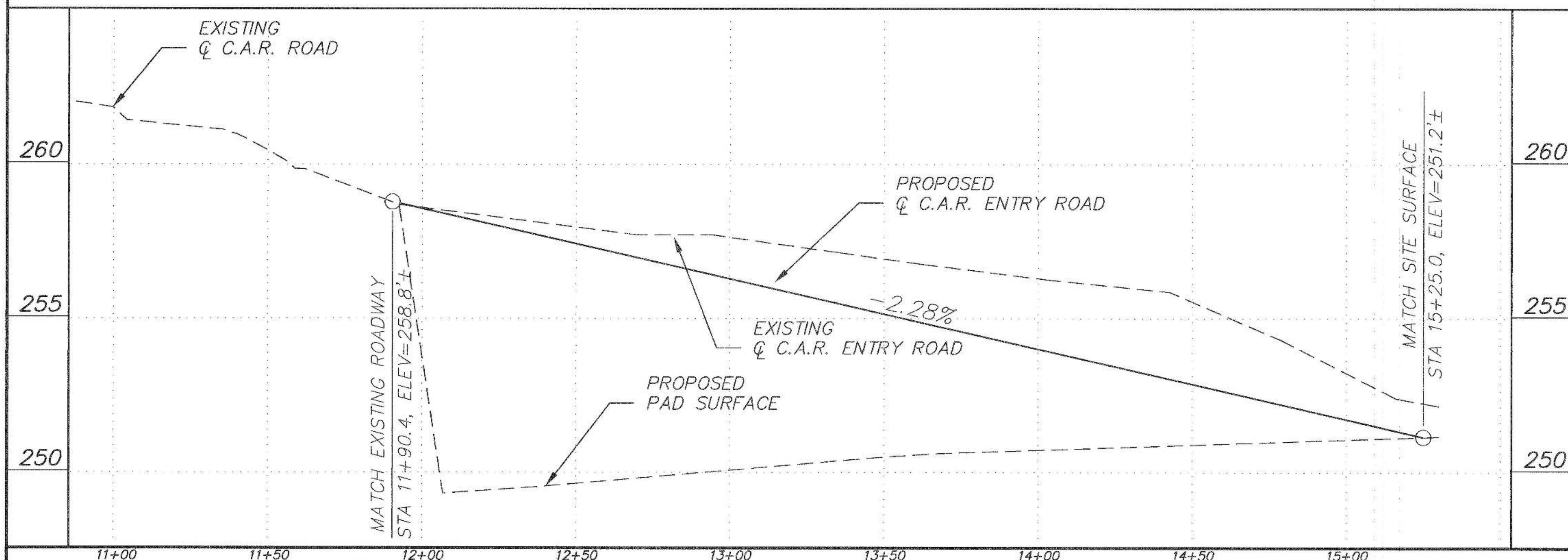
FILE NO. 04-1150





A ROAD CROSS SECTION

NTS



FIELD BOOKS	BM NO.	LOCATION	ELEV.
DESIGN: NUMBERS	GAAB-66	–	238.10
	TS-2		250.78
STAKING:	TS-3		244.34
ASBUILT:			
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. DATUM		
INSPECTOR:			
CONSTRUCTION RECORD	VERTICAL DATUM		

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	–	–	TELEPHONE	–	–
TOPOGRAPHY	–	–	ELECTRIC	–	–
PROFILE	–	–	CABLE TV	–	–
SANITARY SEWER	–	–	DESIGN	MJM	JLG
STORM SEWER	–	–	QUANTITIES	JLG	–
WATER	–	–	MUN. FINAL CHECK		
GAS	–	–			

PLAN CHECK

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY

REVISIONS

SEAL

STATE OF ALASKA 49th STEPHEN D. SHRADER No. CE 4148 7/18/04 REGISTERED PROFESSIONAL ENGINEER

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

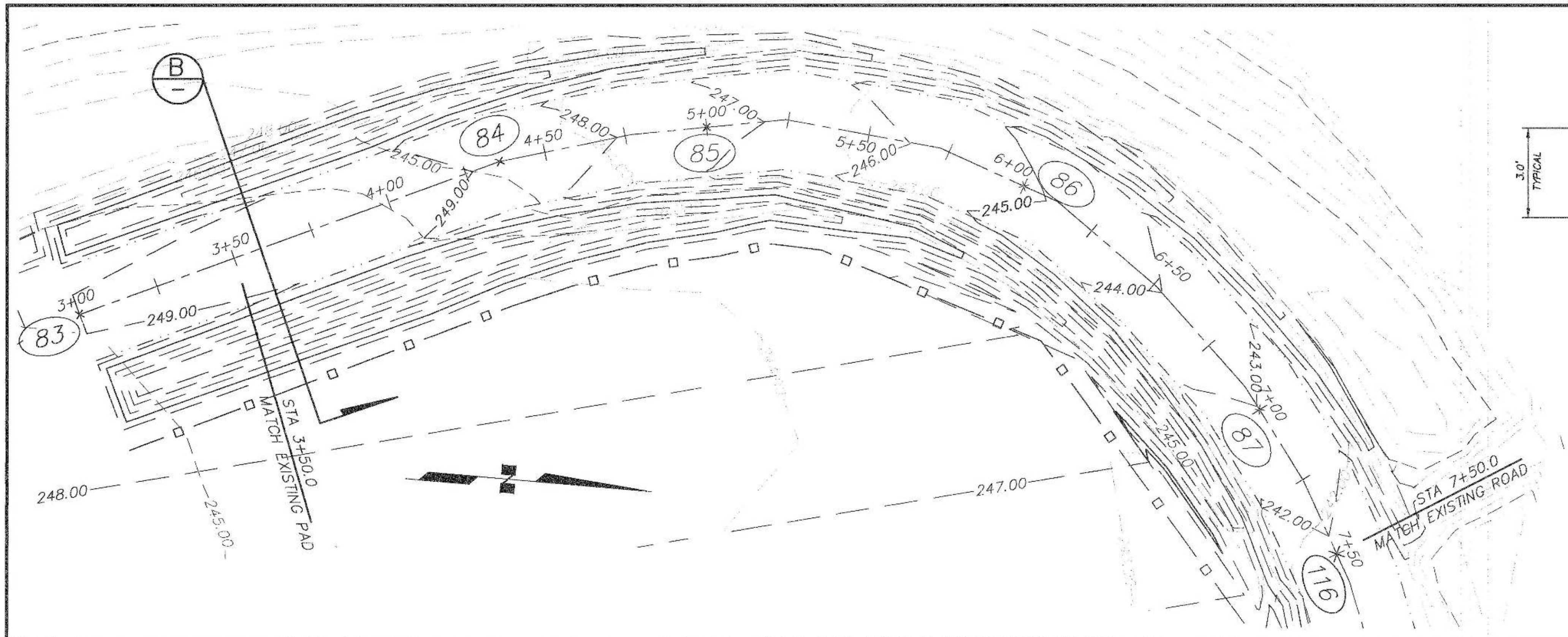
01-21 TUDOR ROAD/CAMPBELL AIRSTRIP ROAD AREA SNOW DISPOSAL SITE WATER QUALITY UPGRADE SCHEDULE A

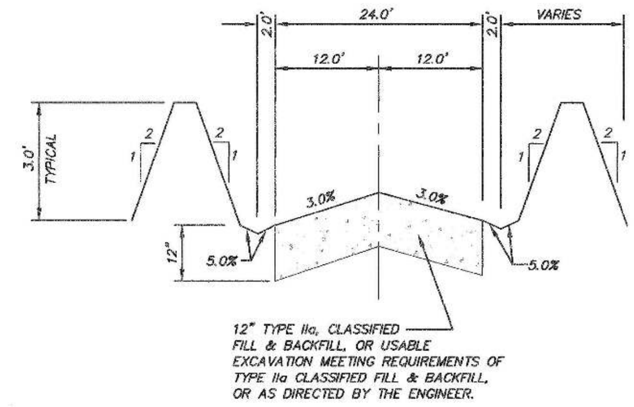
ROADWAY PLAN AND PROFILE

CAMPBELL AIRSTRIP ENTRY ROAD

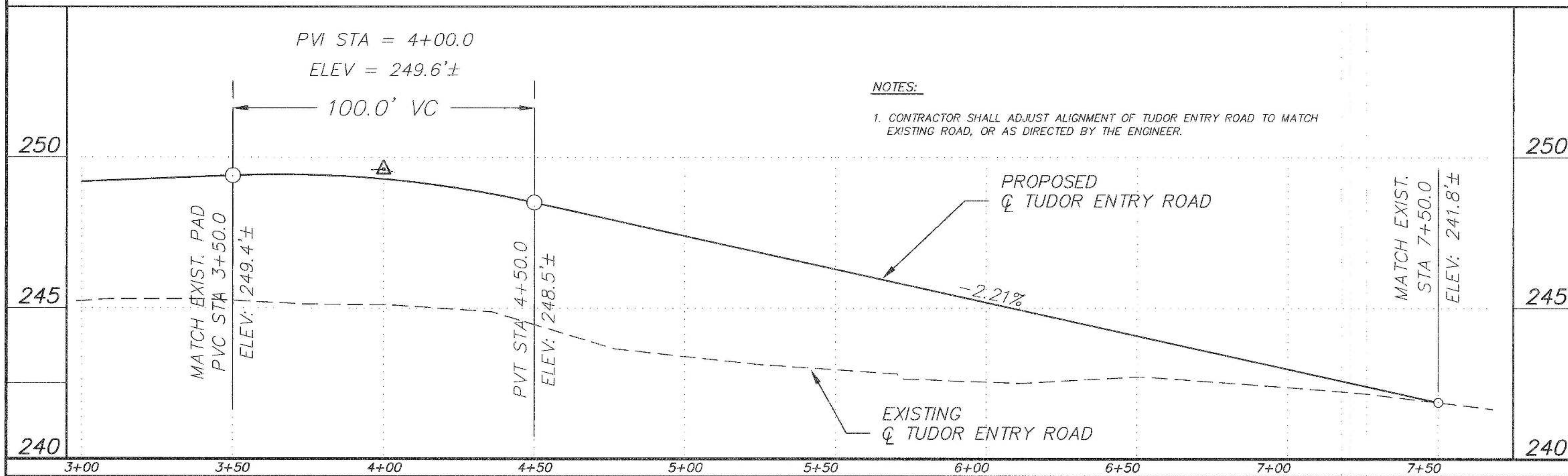
SCALE: HOR. 1"=20' VER. 1"=4' | DATE: 7/15/2004 | GRID: 1838 | ACCT. NO. | SHEET 6 of 10

FILE NO. 04-1151





B ROAD CROSS SECTION
NTS



NOTES:

1. CONTRACTOR SHALL ADJUST ALIGNMENT OF TUDOR ENTRY ROAD TO MATCH EXISTING ROAD, OR AS DIRECTED BY THE ENGINEER.

FIELD BOOKS	BM NO.	LOCATION	ELEV.	DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
DESIGN: NUMBERS	GAAB-66	–	238.10	BASE	–	–	TELEPHONE	–	–
				TOPOGRAPHY	–	–	ELECTRIC	–	–
STAKING:				PROFILE	–	–	CABLE TV	–	–
				SANITARY SEWER	–	–	DESIGN	MJM	JLG
ASBUILT:				STORM SEWER	–	–	QUANTITIES	JLG	–
				WATER	–	–	MUN. FINAL CHECK		
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. DATUM			GAS	–	–			
INSPECTOR:									
CONSTRUCTION RECORD	VERTICAL DATUM			PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY

REVISIONS

SEAL

STATE OF ALASKA
49th
STEPHEN D. SHRADER
No. CE 4148
REGISTERED PROFESSIONAL ENGINEER

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

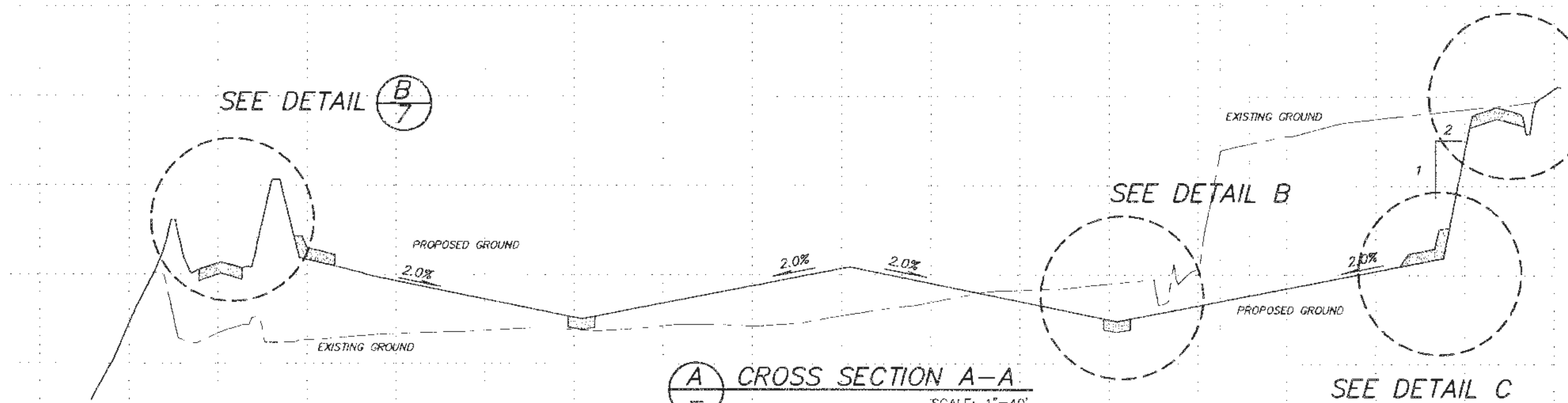
01-21 TUDOR ROAD/CAMPBELL AIRSTRIP ROAD SCHEDULE A
AREA SNOW DISPOSAL SITE WATER QUALITY UPGRADE

ROADWAY PLAN AND PROFILE

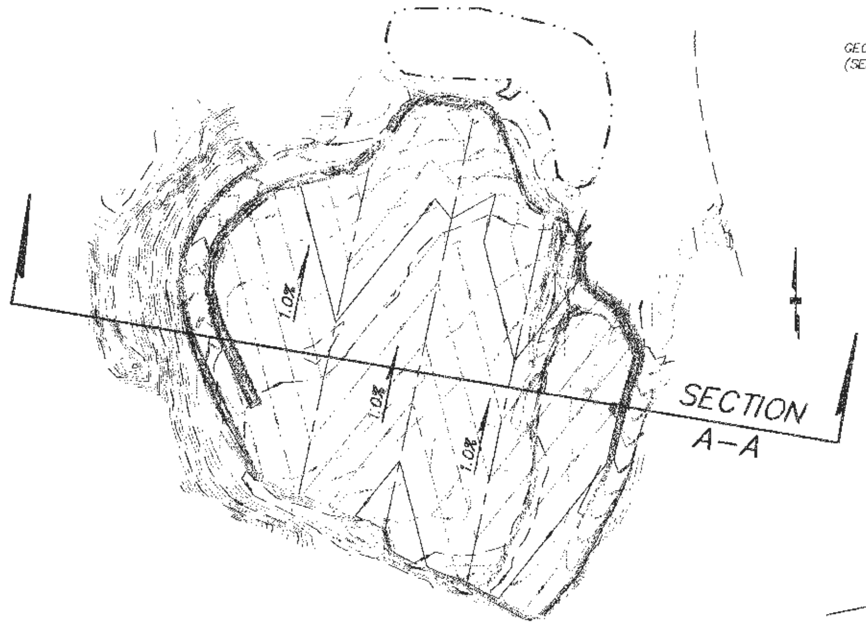
TUDOR ENTRY ROAD

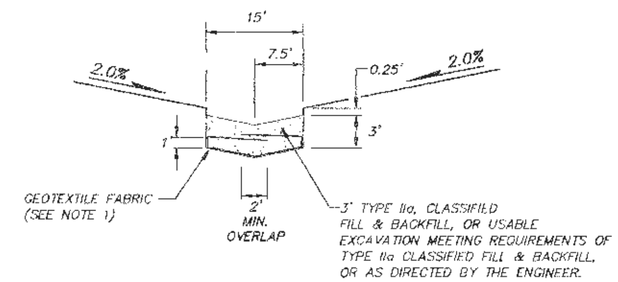
SCALE: HOR. 1"=20' VER. 1"=4' | DATE: 7/15/2004 | GRID: 1838 | ACCT. NO. | SHEET 7 of 10

FILE NO. 04-1152



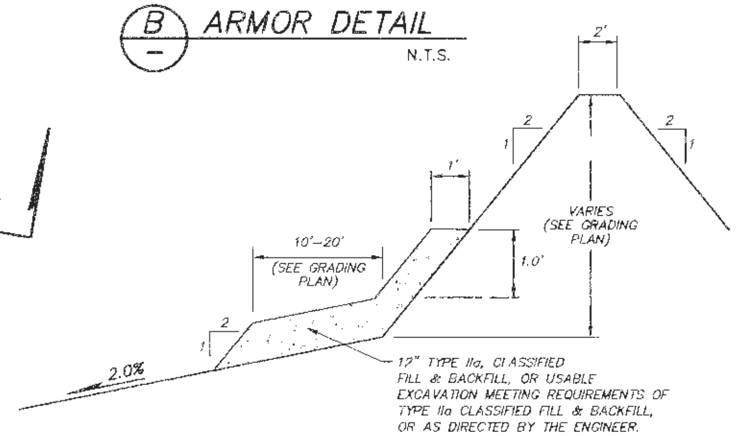
A CROSS SECTION A–A
SCALE: 1"=40'



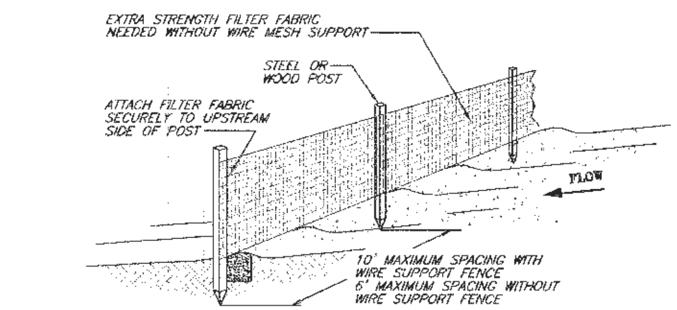


NOTE:
1. GEOTEXTILE FABRIC SHALL BE A WOVEN MATERIAL.

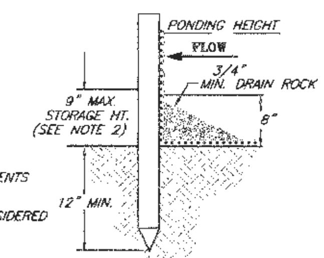
B ARMOR DETAIL
N.T.S.



C ARMOR/BERM DETAIL
N.T.S.



NOTES:
1. PLACE SILT FENCE ON SLOPE CONTOURS TO MAXIMIZE PONDING EFFICIENCY.
2. INSPECT AND REPAIR FENCE AFTER EACH STORM EVENT AND REMOVE SEDIMENT WHEN NECESSARY. 9" MAXIMUM STORAGE HEIGHT.
3. CONTRACTOR SHALL DISPOSE REMOVED SEDIMENTS TO CONTRACTOR FURNISHED DISPOSAL AREA IN A MANNER THAT WILL CONTAIN SEDIMENTS WITHIN THE DISPOSAL AREA. THIS WORK SHALL BE CONSIDERED INCIDENTAL TO THE PAY ITEM "SILT FENCE" AND NO ADDITIONAL PAYMENT SHALL BE MADE.



INSTALLATION WITHOUT TRENCHING

NOT TO SCALE

D SILT FENCE DETAIL
N.T.S.

FIELD BOOKS	BM NO.	LOCATION	ELEV.	DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY	REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
DESIGN: NUMBERS	GAAB–66	–	238.10	BASE	–	–	TELEPHONE	–	–								
				TOPOGRAPHY	–	–	ELECTRIC	–	–								
STAKING:				PROFILE	–	–	CABLE TV	–	–								
				SANITARY SEWER	–	–	DESIGN	MJM	JLG								
ASBUILT:				STORM SEWER	–	–	QUANTITIES	JLG	–								
				WATER	–	–	MUN. FINAL CHECK										
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. DATUM			GAS	–	–											
INSPECTOR:																	
CONSTRUCTION RECORD	VERTICAL DATUM			PLAN CHECK						REVISIONS							

SEAL

STATE OF ALASKA
49th
STEPHEN D. SHRADER
No. CE 4148
REGISTERED PROFESSIONAL ENGINEER
SEAL

MUNICIPALITY OF ANCHORAGE

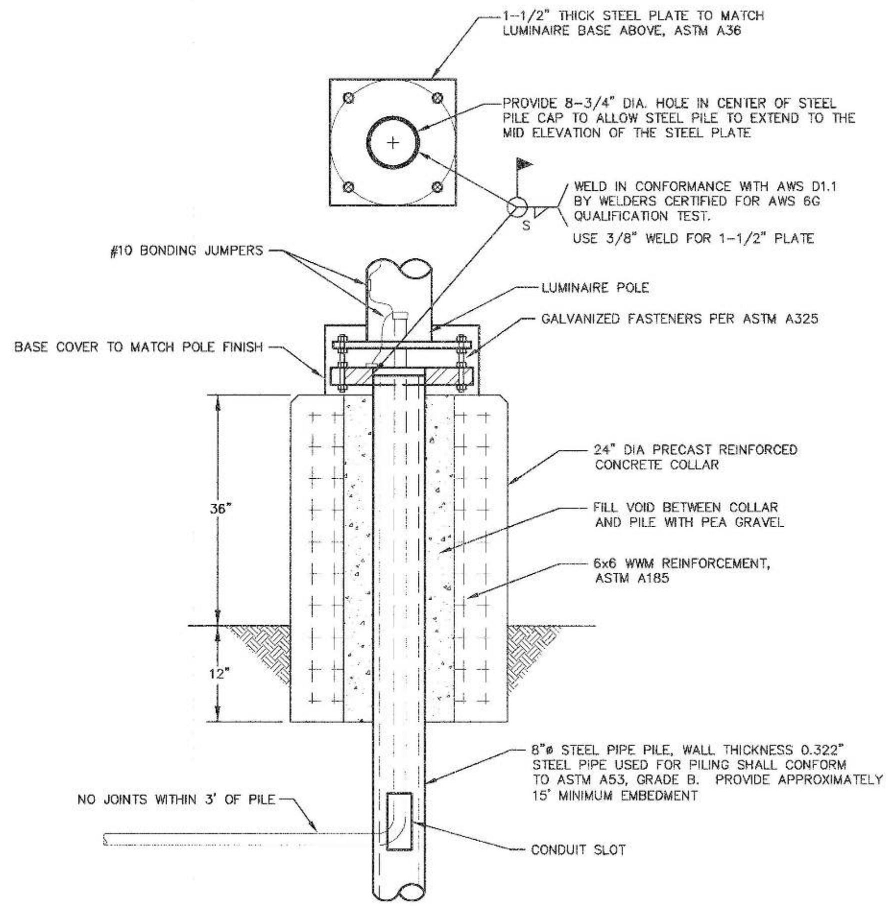
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

01–21 TUDOR ROAD/CAMPBELL AIRSTRIP ROAD AREA SNOW DISPOSAL SITE WATER QUALITY UPGRADE SCHEDULE A

DETAILS/CROSS–SECTION

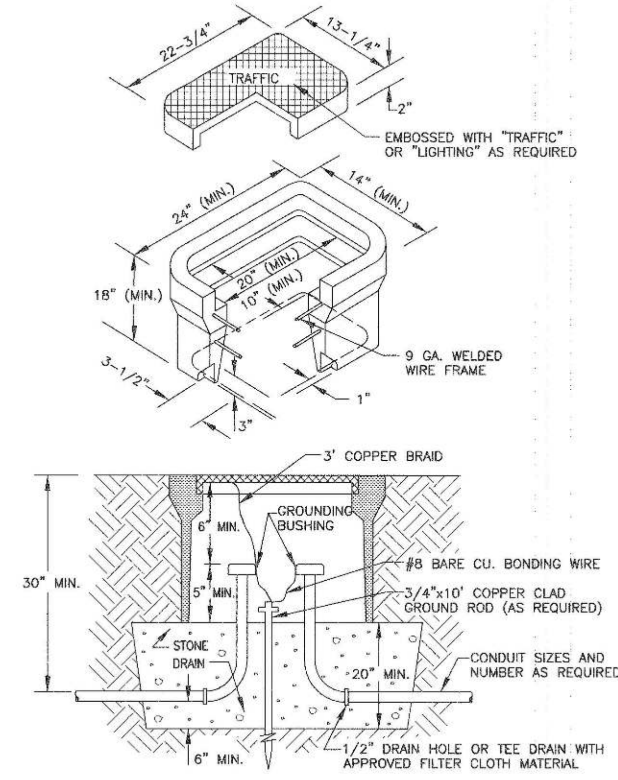
SCALE: AS NOTED | DATE: 7/15/2004 | GRID: 1839 | ACCT. NO. | SHEET 8 of 10

FILE NO. 04–1153



1/9 LIGHT POLE BASE DETAIL

NTS



2/9 TYPE 1A JUNCTION BOX DETAIL

NTS

USE THIS DETAIL IN LIEU OF 1994 MASS STD. DETAIL 80-26.

ELECTRICAL LEGEND

LIGHTING

POLE MOUNTED LIGHT FIXTURE, EXISTING/NEW

POWER / CONTROL

LOAD CENTER, EXISTING/NEW

JUNCTION BOX, TYPE 1A, EXISTING/NEW

JUNCTION BOX, TYPE II, EXISTING/NEW

UNDERGROUND CIRCUIT

EXISTING CIRCUIT TO BE REMOVED

EXISTING CIRCUIT TO REMAIN

CIRCUIT BREAKER

NORMALLY CLOSED/NORMALLY OPEN CONTACTS

NOTATION

REFERENCE TO SHEET NOTE

REFERENCE TO REVISION

REFERENCE DRAWINGS

80-30 POST MOUNTED LOAD CENTER – TYPE 2 (WITHOUT METER)

EXISTING LOAD CENTER–PANEL A

CKT	LOAD	BRANCH BKR	BRANCH VA	CONN KVA A	CONN KVA B	BRANCH VA	BRANCH BKR	LOAD	CKT
1	CONTACTOR – NOTE 1	30/2		2.7		2700	50/2	LOADCENTER C – SNOW DUMP	2
3					2.4	2400		NOTE 2	4
5	SIGNAL POWER – NOTE 1	80/2		0.0					6
7					0.0				8
9	SPARE – NOTE 1	20/1		0.0					10
11					0.0				12
	EXISTING PEAK DEMAND OVER		2965	3.0					
	LAST 12 MONTHS		2965		3.0				
	CONNECTED LOAD	11.0 KVA / 46 AMPS		5.7 / 47	5.4 / 45				
	NEC DEMAND	11.1 KVA / 46 AMPS							

PANEL NOTES
1. EXISTING CIRCUIT TO REMAIN
2. NEW CIRCUIT BREAKER

PANEL SPECIFICATIONS
- MAINS RATING AMPS – 100
- MAIN CIRCUIT BREAKER AMPERES – 100
- CAPACITY ONE-POLE CIRCUITS – 12
- SYSTEM VOLTAGE – 240/120
- PHASE, NO. OF WIRES – 1 PH, 3 W
- AIC RATING – 10,000
- MOUNTING – TYPE 5

NEW LOAD CENTER C

CKT	LOAD	BRANCH BKR	BRANCH VA	CONN KVA A	CONN KVA B	BRANCH VA	BRANCH BKR	LOAD	CKT
1	AREA LIGHT	20/1	300	1.5		1200	20/2	HEADBOLT RECEPTACLE	2
3					1.2	1200			4
5				1.2		1200	20/1	HEADBOLT RECEPTACLE	6
7					1.2	1200	20/1	HEADBOLT RECEPTACLE	8
9				0.0					10
11					0.0				12
	CONNECTED LOAD	5.1 KVA / 21 AMPS		2.7 / 23	2.4 / 20				
	NEC DEMAND	5.2 KVA / 22 AMPS							

PANEL NOTES
1. TYPE 2 POST MOUNTED LOAD CENTER, WITHOUT METER SECTION

PANEL SPECIFICATIONS
- MAINS RATING AMPS – 100
- MAIN CIRCUIT BREAKER AMPERES – MLO
- CAPACITY ONE-POLE CIRCUITS – 12
- SYSTEM VOLTAGE – 240/120
- PHASE, NO. OF WIRES – 1 PH, 3 W
- AIC RATING – 10,000
- MOUNTING – POST

FIELD BOOKS: DESIGN: NUMBERS; STAKING:; ASBUILT:; CONTRACTOR:; INSPECTOR: — CONSTRUCTION RECORD

BM NO. | LOCATION | ELEV. — BASIS OF DATUM: 1972 N.G.S. DATUM — VERTICAL DATUM

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	–	–	TELEPHONE	–	–
TOPOGRAPHY	–	–	ELECTRIC	LPS	GRH
PROFILE	–	–	CABLE TV	–	–
SANITARY SEWER	–	–	DESIGN	–	–
STORM SEWER	–	–	QUANTITIES	–	–
WATER	–	–	MUN. FINAL CHECK		
GAS	–	–			

PLAN CHECK

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY

REVISIONS

STATE OF ALASKA 49TH GARY R. HABLE EE 10243 REGISTERED PROFESSIONAL ENGINEER — SEAL

SEAL

MUNICIPALITY OF ANCHORAGE

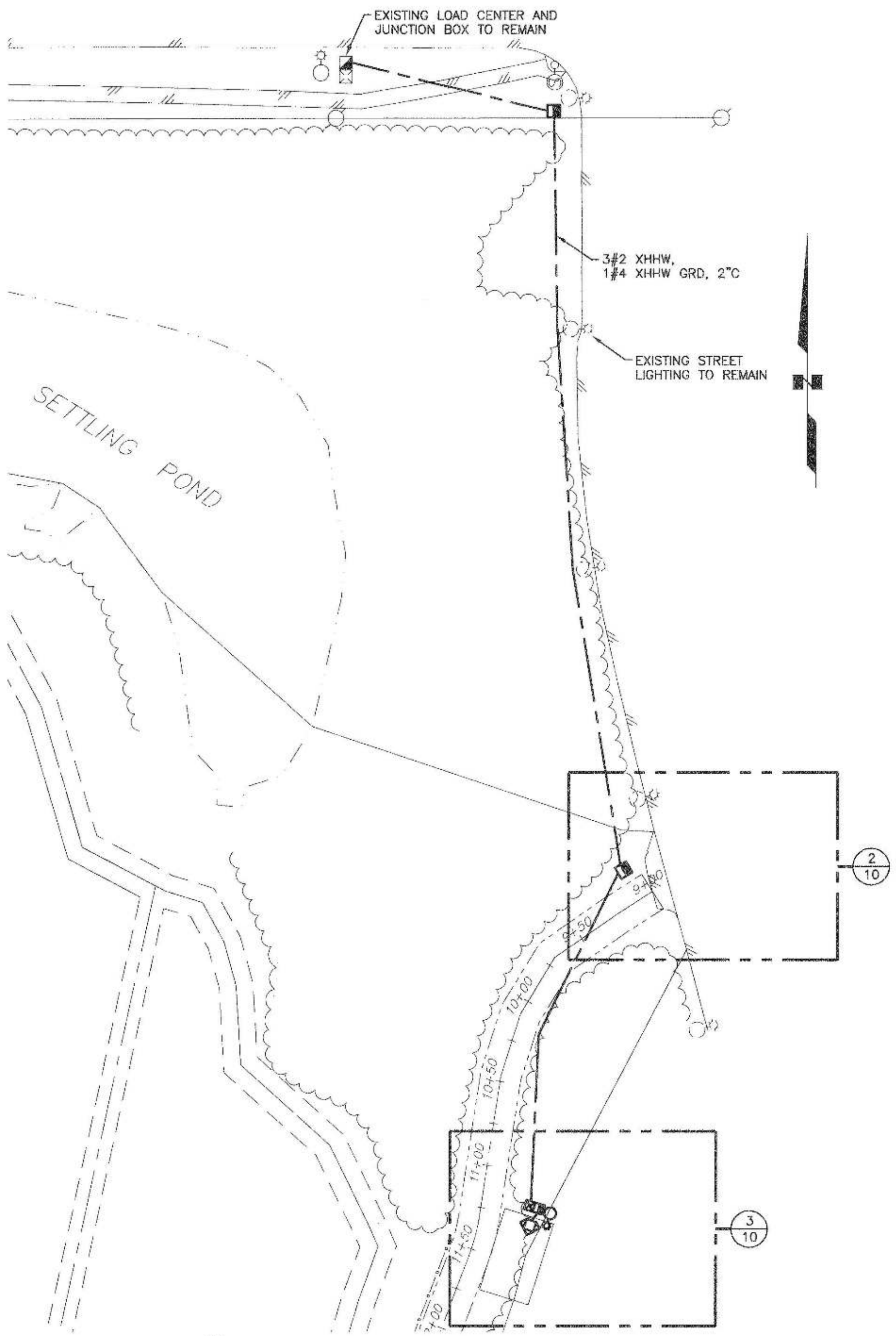
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

01-21 TUDOR ROAD/CAMPBELL AIRSTRIP ROAD AREA SNOW DISPOSAL SITE WATER QUALITY UPGRADE — SCHEDULE B

ELECTRICAL SYMBOLS AND DETAILS

SCALE: NTS | DATE: 8/11/04 | GRID: 1838 | ACCT. NO. | SHEET 9 of 10

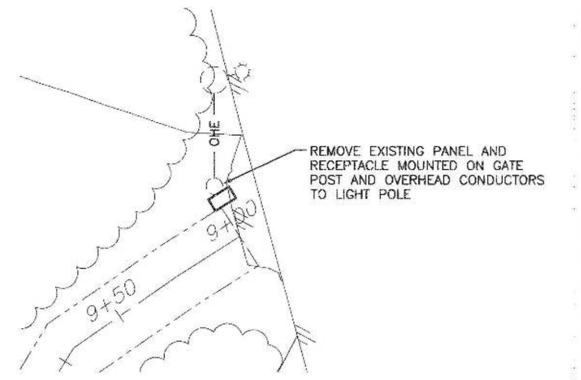
FILE NO. 04-1154



3/10 SITE PLAN

1" = 50'-0"

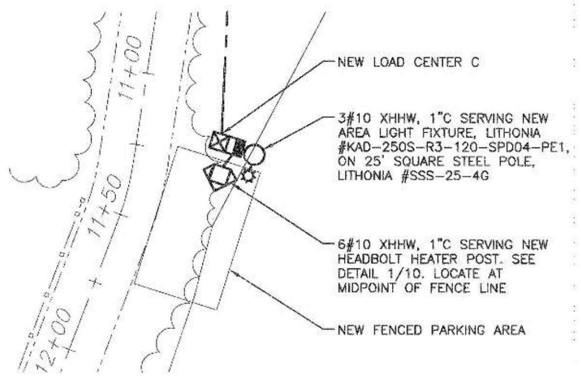
0 25 50 100
SCALE IN FEET



2/10 DEMOLITION PLAN

1" = 30'-0"

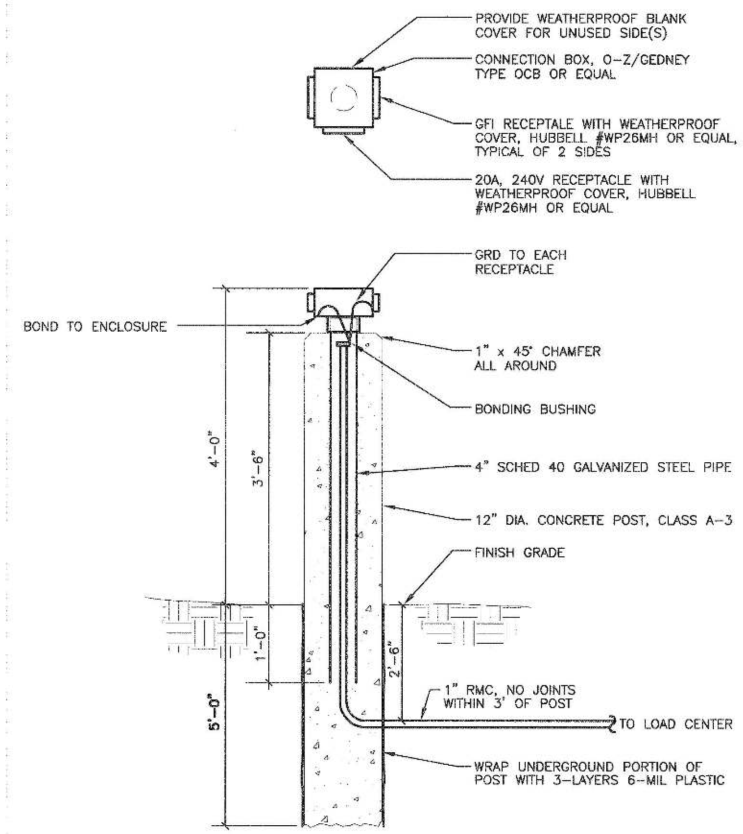
0 15 30 60
SCALE IN FEET



3/10 ENLARGED PLAN

1" = 30'-0"

0 15 30 60
SCALE IN FEET



1/10 HEADBOLT HEATER POST DETAIL

NTS

GENERAL PROJECT NOTES:

1. OTHER UNDERGROUND UTILITIES IN THE AREA. LOCATE ALL EXISTING UTILITIES BEFORE PROCEEDING WITH WORK. USE CAUTION WHEN EXCAVATING.
2. REMOVE SURFACE MATERIALS AS REQUIRED FOR INSTALLATION OF CONDUIT, BACKFILL TO MATCH EXISTING GRADE, PROVIDE NEW SURFACE MATERIAL TO MATCH EXISTING.
3. FIELD VERIFY LOCATIONS OF LOADCENTER, JUNCTION BOX, HEADBOLT HEATER POST, AND LIGHT POLE WITH ENGINEER AND FENCE/GATE LAYOUT PRIOR TO INSTALLATION.

FIELD BOOKS	BM NO.	LOCATION	ELEV.
DESIGN: NUMBERS			
STAKING:			
ASBUILT:			
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. DATUM		
INSPECTOR:			
CONSTRUCTION RECORD	VERTICAL DATUM		

PLAN CHECK

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	—	—	TELEPHONE	—	—
TOPOGRAPHY	—	—	ELECTRIC	LPS	GRH
PROFILE	—	—	CABLE TV	—	—
SANITARY SEWER	—	—	DESIGN	—	—
STORM SEWER	—	—	QUANTITIES	—	—
WATER	—	—	MUN. FINAL CHECK		
GAS	—	—			

REVISIONS

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY

SEAL: STATE OF ALASKA 49TH GARY R. HABLE EE-10243 REGISTERED PROFESSIONAL ENGINEER

SEAL

MUNICIPALITY OF ANCHORAGE

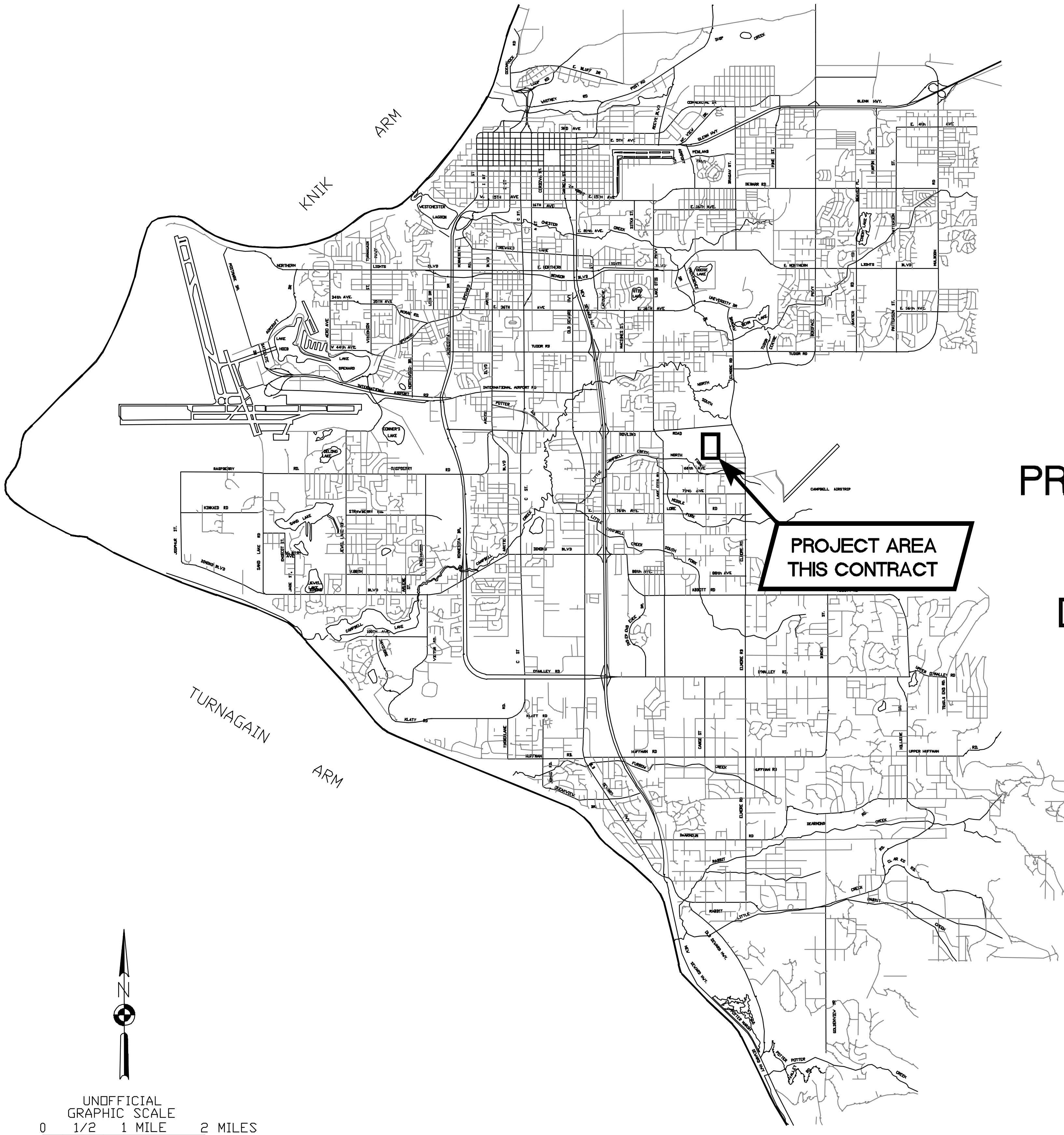
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

01-21 TUDOR ROAD/CAMPBELL AIRSTRIP ROAD AREA SNOW DISPOSAL SITE WATER QUALITY UPGRADE — SCHEDULE B

ELECTRICAL PLAN AND DETAILS

SCALE: AS SHOWN | DATE: 8/11/04 | GRID: 1838 | ACCT. NO. | SHEET 10 of 10

FILE NO. 04-1155



ANCHORAGE ALASKA

MUNICIPALITY OF ANCHORAGE
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

PROJECT NO. 04-27

APPROVED BY:

DAN SULLIVAN
MAYOR

J.W. HANSEN
DEPUTY DIRECTOR

95% SUBMITTAL

DOWL FILE No: 234-43

P:\Projects\D59879\DESIGN\DSI-SNOWD.dwg 2011-6-7 14:52:38 USER: OCT

LEGEND

PROPOSED / EXISTING

- PROPERTY LINE
- EASEMENT
- WATER LINE (—W—)
- SANITARY SEWER LINE (—SS—)
- STORM DRAIN LINE (—SD—)
- GAS LINE (—G—)
- UNDERGROUND TELEPHONE LINE (—UG/T—)
- OVERHEAD ELECTRIC LINE (—OH/E—)
- CENTERLINE
- EDGE OF PAVEMENT
- ROCK/GRAVEL PILE
- TREE LINE
- FENCE LINE (—X—)
- CONTOUR LINE (—67—)
- BUILDING
- DRAINAGE ROCK
- APPROXIMATE WETLAND BOUNDARY
- GRAVEL TRAIL
- BIOSWALE
- APPROXIMATE POND BOUNDARY

PROPOSED / EXISTING

- LIGHT POLE
- WATER VALVE
- UTILITY POLE
- FIRE HYDRANT
- SANITARY SEWER MANHOLE
- SANITARY SEWER CLEANOUT
- ELECTRIC PEDESTAL
- ELECTRIC JUNCTION BOX
- TELEPHONE PEDESTAL
- GAS METER (G.M.)
- STORM DRAIN MANHOLE
- CATCH BASIN
- STORM DRAIN CATCH BASIN MANHOLE
- STORM DRAIN CLEANOUT
- BOLLARD
- OIL/WATER SEPARATOR
- CONTROL POINT (971)
- SNOW BOUNDARY MARKER

REFERENCED MASS DETAILS

GENERAL NOTES

1. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE 2009 MUNICIPALITY OF ANCHORAGE STANDARD SPECIFICATIONS (MASS) AS CURRENTLY AMENDED.
2. EXISTING GROUND CONTOURS BASED ON DOWL HKM TOPOGRAPHIC SURVEY PERFORMED MAY 2009. CONTRACTOR SHALL VERIFY SITE CONDITIONS.
3. SOILS INFORMATION IS DERIVED FROM SOILS INVESTIGATIONS PERFORMED BY DOWL HKM. SEE GEOTECHNICAL REPORT DATED DECEMBER 2009 AND TITLED: SUBSURFACE EXPLORATION AND FOUNDATION RECOMMENDATIONS DOWLING ROAD/ SPRUCE STREET AREA SNOW DISPOSAL.
4. VERIFY INVERTS AND LOCATIONS OF ALL UTILITY CONNECTION POINTS PRIOR TO INSTALLING PIPE. REPORT DISCREPANCIES FROM PLANS IMMEDIATELY TO ENGINEER.
6. ELEVATIONS SHOWN ARE TO PIPE INVERT, FLOW LINE, OR FINISH PAVEMENT SURFACE UNLESS NOTED OTHERWISE.
7. DIMENSIONS SHOWN ARE TO EDGE OF PAVEMENT, GRADE BREAK, EDGE OF CONCRETE, BACK OF CURB, OR FACE OF SIDEWALK UNLESS NOTED OTHERWISE.
8. ALL CURB RADII ARE MEASURED AT THE BACK OF CURB, EDGE OF CONCRETE, OR FACE OF SIDEWALK.
9. THE CONTRACTOR SHALL FOLLOW ALL MUNICIPALITY OF ANCHORAGE REGULATIONS FOR NOISE, HOURS OF OPERATIONS, AND DUST.
10. PIPE BEDDING SHALL BE CLASS C PER MASS. TRENCH BACKFILL SHALL BE COMPACTED TO AT LEAST 95% OF MAXIMUM DENSITY.
11. CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS PRIOR TO BEGINNING CONSTRUCTION. THE PERMITS SHALL BE MAINTAINED AT THE JOB SITE.
12. CONTRACTOR SHALL MAINTAIN "REDLINE" RECORD DRAWINGS ON A CLEAN SET OF CONSTRUCTION DRAWINGS IN ACCORDANCE WITH MASS DIVISION 65.00 CONSTRUCTION SPECIFICATIONS FOR CONSTRUCTION SURVEY. THE "REDLINES" SHALL BE KEPT CURRENT ON A DAILY BASIS AND SHALL BE AVAILABLE TO THE ENGINEER FOR INSPECTION ON THE JOBSITE. CONTRACTOR SHALL RECORD SURVEY NOTES AND SUBMIT DAILY TO THE ENGINEER.
13. CONTRACTOR SHALL RECORD SURVEY NOTES FOR SUBMITTAL WITH AS-BUILT PLANS, INCLUDING HORIZONTAL AND VERTICAL LOCATIONS OF ALL UTILITIES ENCOUNTERED IN THE FIELD. CONTRACTOR SHALL RECORD ALL DEVIATIONS FROM THE PLANS.
14. LOCATIONS DEPICTED FOR THE UTILITIES AND OTHER EXISTING FEATURES ARE APPROXIMATE. SOME UTILITIES HAVE BEEN LOCATED FROM AS-BUILT DRAWINGS AND SOME FROM UTILITY COMPANY LOCATES, AND THEREFORE MAY NOT BE VISIBLE. CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING AND VERIFYING ALL UTILITIES AND SHALL EXCERCISE CAUTION DURING CONSTRUCTION.
15. SHORING OF UTILITY POLES SHALL BE CONSIDERED INCIDENTAL TO THE PROJECT AND NO SEPARATE PAYMENT SHALL BE MADE.
16. UNDERGROUND AND OVERHEAD ELECTRICAL AND TELECOMMUNICATION LINES AND POLES OCCUR WITHIN THE PROJECT AREA; CONTRACTOR SHALL COORDINATE WORK ACCORDINGLY. ALL WORK IN CLOSE PROXIMITY TO EXISTING LINES AND POLES SHALL COMPLY WITH APPLICABLE FEDERAL, STATE, AND LOCAL STATUTES, CODES AND GUIDELINES, AND THE ELECTRICAL FACILITY CLEARANCE REQUIREMENTS OF THE GOVERNING UTILITY. HAND DIGGING IS REQUIRED WITHIN TWO FEET OF BURIED ELECTRICAL CABLE. SOME UTILITIES HAVE BEEN LOCATED FROM AS-BUILT DRAWINGS AND MAY NOT BE VISIBLE.
17. CONTRACTOR SHALL RESTORE DISTURBED PROPERTY TO PRECONSTRUCTION CONDITION(S), UNLESS OTHERWISE DIRECTED BY THE ENGINEER. PAYMENT FOR RESTORING DISTURBED PROPERTY SHALL BE CONSIDERED INCIDENTAL TO THE PROJECT AND NO SEPARATE PAYMENT SHALL BE MADE.

CONSTRUCTION NOTES

1. WATER RESULTING FROM CONTRACTOR'S DEWATERING EFFORT MAY NOT BE PUMPED OR OTHERWISE DIVERTED INTO EXISTING STORM DRAINS UNLESS REQUIRED PERMITS, INCLUDING, BUT NOT LIMITED TO, THE MOA STORMWATER TREATMENT PLAN REVIEW OFFICE, ARE OBTAINED BY THE CONTRACTOR. UNDER NO CIRCUMSTANCES WILL THE CONTRACTOR BE ALLOWED TO DIVERT WATER FROM THE EXCAVATION ONTO ROADWAY. CONTRACTOR SHALL PROVIDE DISPOSAL SITE FOR EXCESS WATER AND SHALL BE RESPONSIBLE FOR SECURING ALL NECESSARY PERMITS AND APPROVALS. CONTRACTOR SHALL PROVIDE COPIES OF PERMITS AND APPROVALS TO THE MOA ROW PERMIT OFFICE.
2. DISCHARGE OFF-SITE OF SILT-LADEN RUNOFF IS FORBIDDEN.
3. MAINTAIN SUPPLY OF OIL ABSORBENT FABRIC ON SITE TO CLEAN MINOR SPILLS.
4. KEEP SITE FREE OF LITTER.
5. MINIMIZE OFF-SITE VEHICLE TRACKING OF SEDIMENTS, SWEEP SITE ENTRANCE AND EXIT DURING CONSTRUCTION WHEN SOILS ACCUMULATE TO DEPTHS GREATER THAN ONE-FOURTH INCH. WATER EXPOSED SOILS AS NECESSARY TO CONTROL GENERATION OF DUST. CONSTRUCTION ACTIVITIES SHALL BE MONITORED ON A DAILY BASIS TO DETERMINE IF TRACKING OF DIRT AND DEBRIS ONTO THE ADJACENT ROADWAYS HAS OCCURRED. ANY CLEANUP NECESSARY SHALL BE ACCOMPLISHED ON A DAILY BASIS.
6. CONTRACTOR SHALL ESTABLISH STABILIZATION MEASURES AFTER DISTURBANCE OF EXISTING VEGETATION NO MORE THAN 14 DAYS AFTER CONSTRUCTION ACTIVITY HAS TEMPORARILY OR PERMANENTLY CEASED ON ANY PORTION OF THE SITE WITH THE FOLLOWING EXCEPTION: WHEN CONSTRUCTION IS PRECLUDED BY SNOWCOVER OR FROZEN GROUND, IN WHICH CASE THEY MUST BE INITIATED AS SOON AS PRACTICABLE. STABILIZATION MEASURES SHALL INCLUDE: STRAW BLANKETS, JUTE MESH FABRIC, OR APPROVED ALTERNATE.
7. WORK ON PROJECT MUST BE CONDUCTED SO SEDIMENT IS NOT TRANSPORTED ONTO ROADWAY OR ADJACENT PROPERTY OR INTO THE DRAINAGE SYSTEM OR WATERWAYS. EROSION AND SEDIMENT CONTROL ARE NECESSARY TO COMPLY WITH FEDERAL, STATE, AND MUNICIPAL LAWS THAT PROHIBIT NON-PERMITTED DISCHARGE OF POLLUTANTS, INCLUDING SEDIMENTS, THAT ARE A RESULT OF EROSION AND OTHER CONSTRUCTION ACTIVITIES. IF DURING THE CONSTRUCTION PHASE OF THE PROJECT, THE TREATED STORM WATER RUNOFF FROM THIS PROJECT CANNOT MEET WATER QUALITY CRITERIA, IT MAY BECOME NECESSARY TO FURTHER IMPROVE THE ON-SITE EROSION AND SEDIMENT CONTROL SYSTEM.

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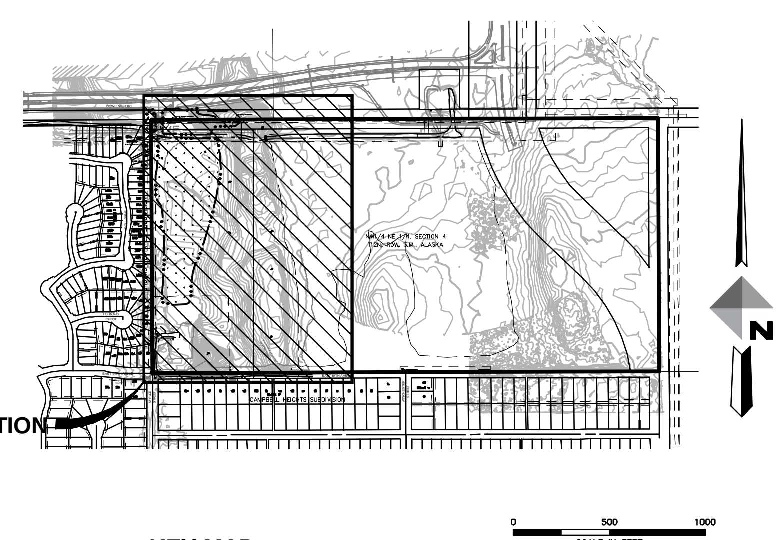
ABBREVIATIONS

ACP	ASPHALT CONCRETE PAVEMENT	IGP	INTRA-GOVERNMENTAL PERMIT	PT	POINT OF TANGENCY
ADEC	ALASKA DEPARTMENT OF ENVIROMENTAL CONSERVATION	INV	INVERT	PUE	PUBLIC USE EASEMENT
ADOT &PF	ALASKA DEPARTMENT OF TRANSPROTATION AND PUBLIC FACILITIES	L	LENGTH OF CURVE	R	RADIUS OF CURVE
ARFS	AS REQUIRED FOR SAFETY	MASS	MUNICIPALITY OF ANCHORAGE STANDARD SPECIFICATIONS, 1994, AS AMENDED	ROW	RIGHT-OF-WAY
AVAP	AS VERTICAL AS POSSIBLE	MAX	MAXIMUM	S	SOUTH
AWW	ALL WEATHER WOOD	ME	MATCH EXISTING	SCH	SCHEDULE
C&G	CURB AND GUTTER	MIN	MINIMUM	SD	STORM DRAIN
CAL	CALIPER	ML&P	MUNICIPAL LIGHT & POWER	SDCB	STORM DRAIN CATCH BASIN
CBMH	CATCH BASIN MANHOLE	MOA	MUNICIPALITY OF ANCHORAGE	SDMH	STORM DRAIN MANHOLE
CC	CURB CUT	MON	MONUMENT	SE	SOUTHEAST
CMP	CORRUGATED METAL PIPE	N	NORTH	SS	SANITARY SEWER
DIA	DIAMETER	NE	NORTHEAST	SSMH	SANITARY SEWER MANHOLE
DIP	DUCTILE IRON PIPE	NIC	NOT IN CONTRACT	STA	STATION
E	EAST	NTS	NOT TO SCALE	SW	SOUTHWEST
ELEV	ELEVATION	NW	NORTHWEST	TBC	TOP BACK OF CURB
ESMT	EASEMENT	OC	ON CENTER	TCP	TEMPORARY CONSTRUCTION PERMIT
F&I	FURNISH AND INSTALL	OD	OUTSIDE DIAMETER	TRW	TOP OF RETAINING WALL
FL	FLOW LINE	PC	POINT OF CURVE	TYP	TYPICAL
GAL	GALLON	PCC	PORTLAND CEMENT CONCRETE	VERT	VERTICAL
GB	GRADE BREAK	PRC	POINT OF REVERSE CURVE	W	WEST
HORIZ	HORIZONTAL	PSF	POUNDS PER SQUARE FOOT	W/	WITH
IAW	IN ACCORDANCE WITH	PSI	POUNDS PER SQUARE INCH		

BEFORE YOU DIG CALL FOR FREE UNDERGROUND LOCATION

Locate Call Center of Alaska
Anchorage Area..................278-3121
Statewide....................800-478-3121
who will notify subscribed utilities only. Other utilities need to be contacted individually.



KEY MAP

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FIELD BOOKS	BM NO.	LOCATION	ELEV.	DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
DESIGN:				BASE	DOWL HKM		TELEPHONE	DOWL HKM	
				TOPOGRAPHY	DOWL HKM		ELECTRIC	DOWL HKM	
STAKING:				PROFILE	DOWL HKM		CABLE TV	DOWL HKM	
				SANITARY SEWER	DOWL HKM		TRAFFIC SIGNAL	DOWL HKM	
ASBUILT:				STORM SEWER	DOWL HKM		DESIGN	DOWL HKM	
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM			WATER	DOWL HKM		QUANTITIES	DOWL HKM	
INSPECTOR:				GAS	DOWL HKM		MUN. FINAL CHECK	DOWL HKM	
CONSTRUCTION RECORD	VERTICAL DATUM			PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
REVISIONS							

SEAL

STATE OF ALASKA 49TH
Bradley M. Melocik
CE 11098
REGISTERED PROFESSIONAL ENGINEER

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

04-27 DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

KEY MAP, NOTES, LEGEND, & ABBREVIATIONS

SCALE: AS SHOWN | DATE 03/18/2011 | GRID 2035 | ACCT. NO. | SHEET 2 of 16

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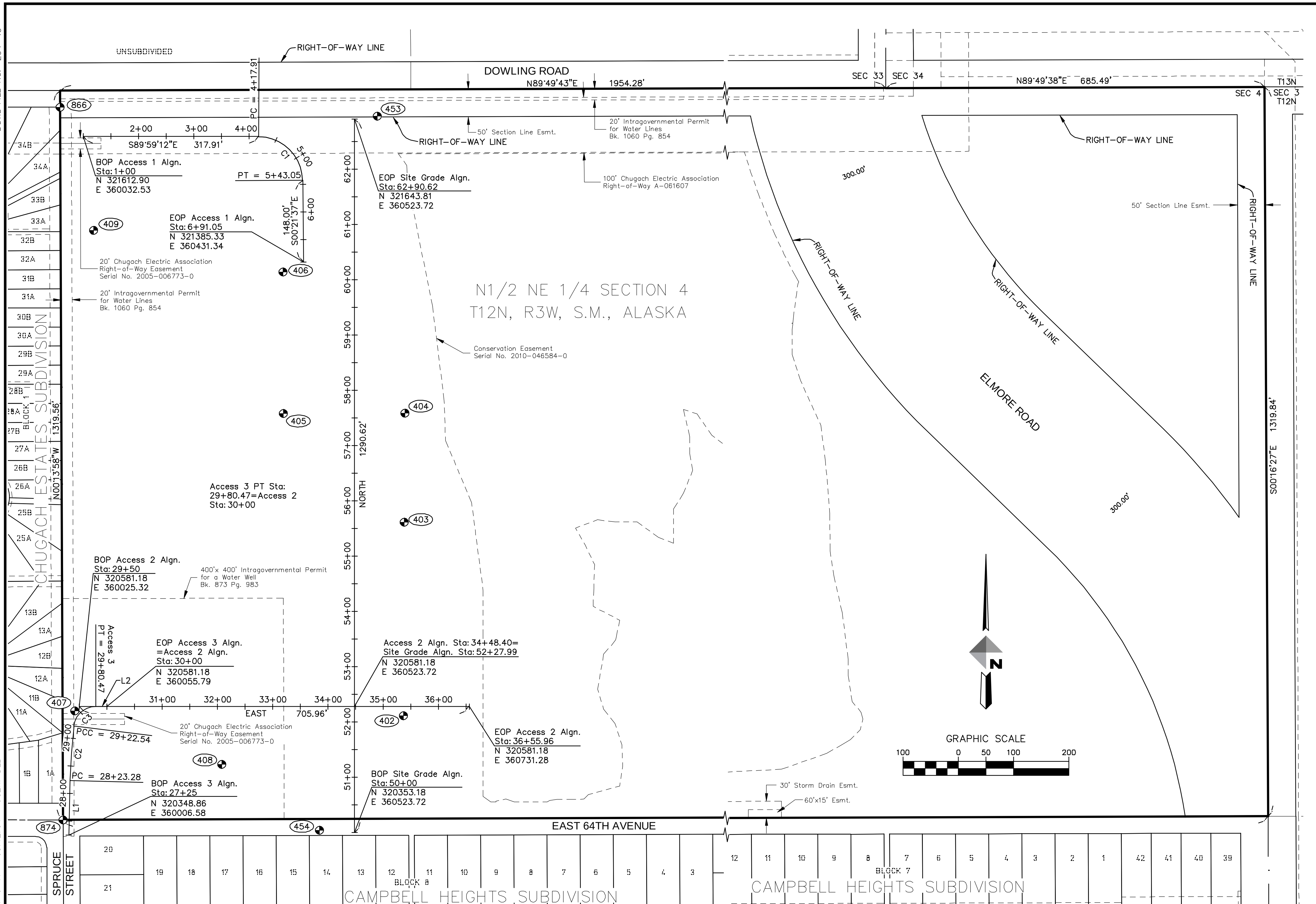

CURVE TABLE			
CURVE	RADIUS	DELTA	LENGTH
C1	80.00	89°37'35"	125.14
C2	1000.00	05°41'14"	99.26
C3	40.00	82°58'52"	57.93

LINE TABLE		
LINE	BEARING	LENGTH
L1	N01°19'54"E	98.28'
L2	EAST	19.53'

LEGEND

- SURVEY MONUMENT
- 901 — CONTROL POINT NUMBER
- BOP — BEGINNING OF PROJECT
- EOP — END OF PROJECT
- 2+00 — ALIGNMENT W/STATIONING

SURVEY CONTROL NOTES

COORDINATE SYSTEM
This project is located entirely within the Anchorage Bowl 2000 adjustment, a local surface grid coordinate system expressed in U.S. Survey feet units developed by the Alaska Department of Transportation.

BASIS OF COORDINATES
The Basis of Coordinates is NGS Station O'Malley, located near the intersection of the New Seward Highway and O'Malley Road. Said station has Anchorage Bowl 2000 coordinates of 303939.2310 N, 353362.5446 E. U.S. Survey Feet.

BASIS OF BEARINGS
The Basis of Bearings is a local plane bearing between NGS Station O'Malley and NGS Station Loop 2 USE RM 3 1964. NGS Station Loop 2 USE RM 3 1964 bears N01°43'26.4"E a distance of 49488.4476 feet from NGS Station O'Malley. NGS Station Loop 2 USE RM 3 1964 has Anchorage Bowl 2000 coordinates of 353405.2778 N, 354851.3982 E. U.S. Survey Feet.

TRANSLATION PARAMENTERS
To convert the local coordinates to NAD83 (92) State Plane coordinates expressed in U.S. Survey Feet, translate using +2296868.6878 N usf, +1312517.4904 E usf, and scale using 0.9998910192.

VERTICAL CONTROL
Elevations are based on the Municipality of Anchorage Vertical Control Network in U.S. Feet. The Basis of Elevations is benchmark "GAAB-116" having a value of 303.99 feet. The Datum is NGS 1972 ADJUST.

TBM 2268-28 is the north bolt of a light pole located at the southeast corner of 68th Avenue and Spruce Street, having an elevation of 165.71 feet.

TBM 2268-29 is the north bolt of the top flange of the fire hydrant located at the northeast corner of 68th Avenue and Spruce Street, having an elevation of 168.73 feet.

WARNING! Temporary Bench Marks (TBM's) may be subject to seasonal movement. TBM elevations should be verified before using for construction.

SURVEY CONTROL POINTS - SITE ACCESS ROAD 1 ALIGNMENT

POINT	STATION	OFFSET	NORTHING	EASTING	ELEVATION	DESCRIPTION
409	1+18.92	170.00 R	321442.90	360051.40	172.55	ALCAP
453	5+03.78	164.08 L	321649.23	360564.95	191.58	ALCAP

SURVEY CONTROL POINTS - SITE ACCESS ROAD 2 ALIGNMENT

POINT	STATION	OFFSET	NORTHING	EASTING	ELEVATION	DESCRIPTION
408	32+08.16	104.48 R	320476.39	360283.47	193.81	ALCAP
454	33+85.03	223.50 R	320357.68	360460.34	176.20	ALCAP
402	35+36.72	16.68 R	320564.49	360612.04	191.75	ALCAP
403	35+38.39	333.87 L	320915.05	360613.70	191.36	ALCAP

SURVEY CONTROL POINTS - SITE ACCESS ROAD 3 ALIGNMENT

POINT	STATION	OFFSET	NORTHING	EASTING	ELEVATION	DESCRIPTION
454	27+44.36	453.44 R	320357.68	360460.34	176.20	ALCAP
874	27+52.26	10.87 L	320376.37	359996.35	165.09	ALCAP
408	28+74.34	272.98 R	320476.39	360283.47	193.81	ALCAP
407	29+45.52	10.26 L	320573.43	360017.25	166.16	ALCAP

SURVEY CONTROL POINTS - SITE GRADE ALIGNMENT

POINT	STATION	OFFSET	NORTHING	EASTING	ELEVATION	DESCRIPTION
454	50+04.49	63.38 L	320357.68	360460.34	176.20	ALCAP
874	50+23.18	527.37 L	320376.37	359996.35	165.09	ALCAP
452	50+40.43	781.89 R	320393.61	361305.61	184.47	REBAR
408	51+23.21	240.25 L	320476.39	360283.47	193.81	ALCAP
402	52+11.31	88.31 R	320564.49	360612.04	191.75	ALCAP
407	52+20.25	506.47 L	320573.43	360017.25	166.16	ALCAP
403	55+61.86	89.98 R	320915.05	360613.70	191.36	ALCAP
405	57+58.56	129.10 L	321111.75	360394.62	175.36	ALCAP
404	57+58.90	90.94 R	321112.08	360614.66	184.43	ALCAP
406	60+14.57	129.42 L	321367.75	360394.30	175.24	ALCAP
409	60+89.71	472.32 L	321442.90	360051.40	172.55	ALCAP

SURVEY CONTROL POINTS

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
866	321665.92	359991.11	172.28	ALMON

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FIELD BOOKS	BM NO.	LOCATION	ELEV.
DESIGN:	GAAB-116	SW COR. ABBOTT RD. & ABBOTT	303.99'
		LOOP RD. BEARING 67.3' FROM	
STAKING:		POWER POLE #A32-R7R1	
ASBUILT:			
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM		
INSPECTOR:			
CONSTRUCTION RECORD	VERTICAL DATUM		

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	DOWL HKM		TELEPHONE	DOWL HKM	
TOPOGRAPHY	DOWL HKM		ELECTRIC	DOWL HKM	
PROFILE	DOWL HKM		CABLE TV	DOWL HKM	
SANITARY SEWER	DOWL HKM		TRAFFIC SIGNAL	DOWL HKM	
STORM SEWER	DOWL HKM		DESIGN	DOWL HKM	
WATER	DOWL HKM		QUANTITIES	DOWL HKM	
GAS	DOWL HKM		MUN. FINAL CHECK	DOWL HKM	
PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
REVISIONS							

SEAL

STATE OF ALASKA 49TH Stanley E. Ponsness LS 6714 REGISTERED PROFESSIONAL LAND SURVEYOR

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

04-27 DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

SURVEY CONTROL

SCALE: AS SHOWN | DATE 6/7/2011 | GRID 2035 | SHEET 3 of 16 | ACCT. NO.

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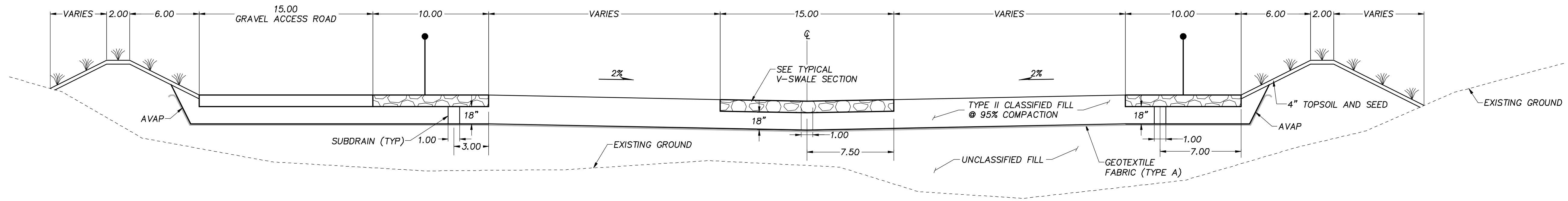
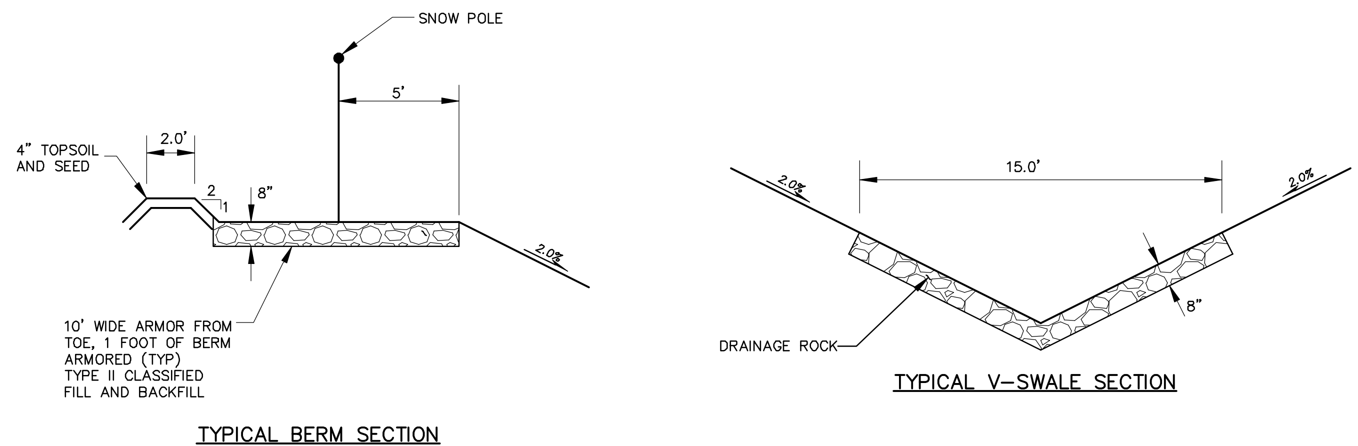
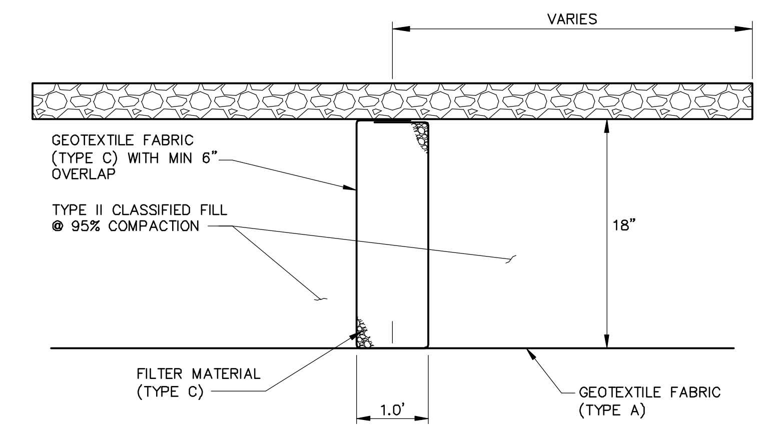


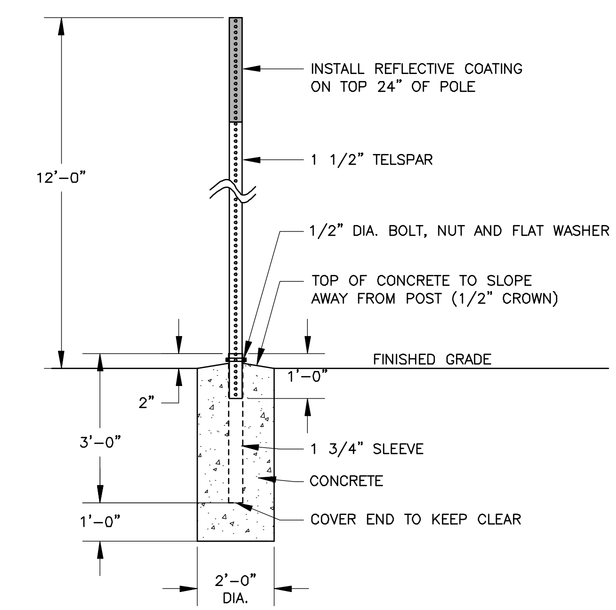
1/4 TYPICAL SECTION
NTS

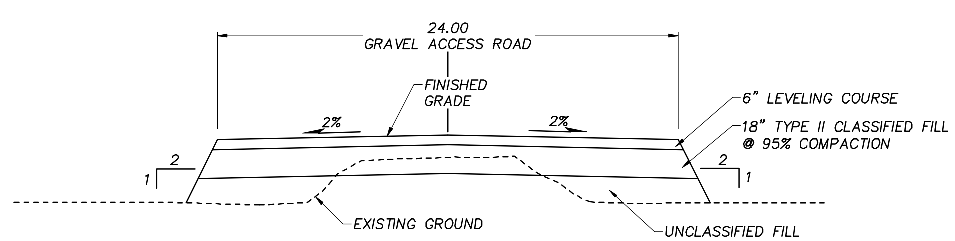


2/4 SECTION DETAILS
NTS



3/4 TYPICAL SUBDRAIN DETAIL
NTS





4/4 ACCESS ROAD TYPICAL SECTION
NTS

5/4 SNOW POLE DETAIL
NTS

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FIELD BOOKS	BM NO.	LOCATION	ELEV.	DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY	REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
DESIGN:				BASE	DOWL HKM		TELEPHONE	DOWL HKM									
				TOPOGRAPHY	DOWL HKM		ELECTRIC	DOWL HKM									
STAKING:				PROFILE	DOWL HKM		CABLE TV	DOWL HKM									
				SANITARY SEWER	DOWL HKM		TRAFFIC SIGNAL	DOWL HKM									
ASBUILT:				STORM SEWER	DOWL HKM		DESIGN	DOWL HKM									
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM			WATER	DOWL HKM		QUANTITIES	DOWL HKM									
INSPECTOR:				GAS	DOWL HKM		MUN. FINAL CHECK	DOWL HKM									
CONSTRUCTION RECORD	VERTICAL DATUM			PLAN CHECK						REVISIONS							

SEAL

STATE OF ALASKA 49TH Bradley M. Melocik CE 11098 REGISTERED PROFESSIONAL ENGINEER

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

04-27 DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

TYPICAL SECTION AND DETAILS

SCALE: AS SHOWN | DATE 03/18/2011 | GRID 2035 | ACCT. NO. | SHEET 4 of 16

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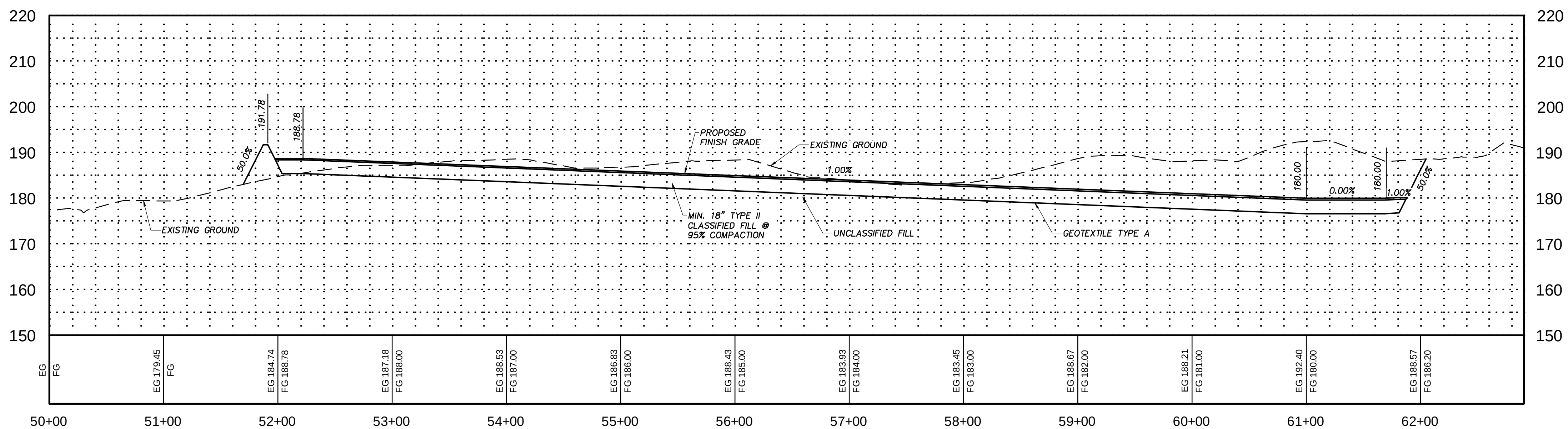
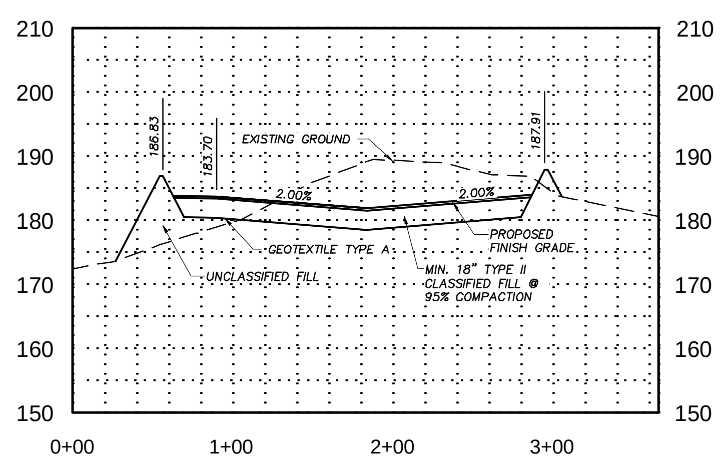


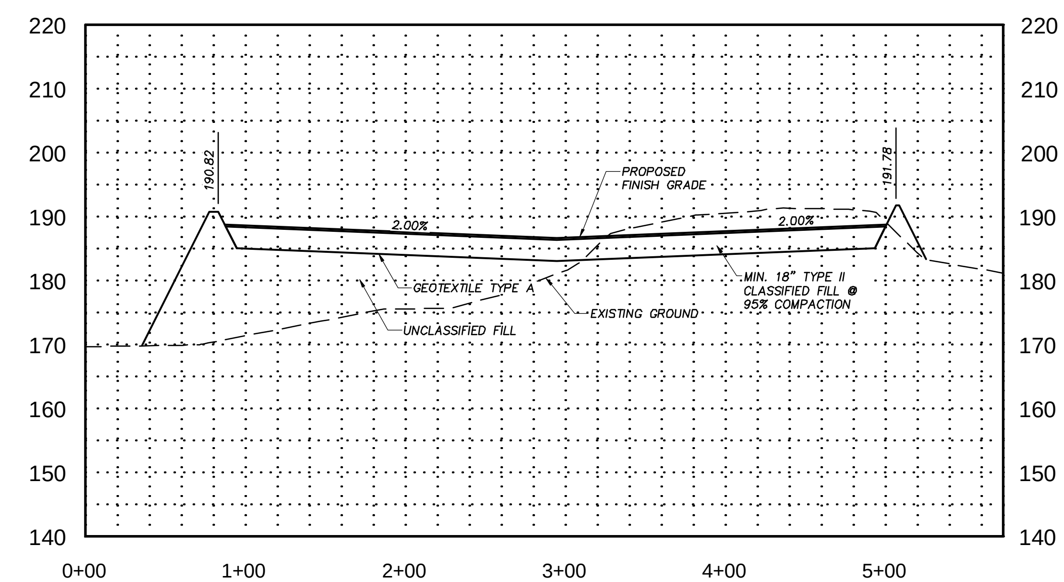
1/5 PROFILE

NTS



2/5 CROSS SECTION 1 - APPROX. STATION 59+08

NTS



3/5 CROSS SECTION 2 - APPROX. STATION 53+53

NTS

95% SUBMITTAL

FIELD BOOKS	BM NO.	LOCATION	ELEV.
DESIGN:			
STAKING:			
ASBUILT:			
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM		
INSPECTOR:			
CONSTRUCTION RECORD	VERTICAL DATUM		

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	DOWL HKM		TELEPHONE	DOWL HKM	
TOPOGRAPHY	DOWL HKM		ELECTRIC	DOWL HKM	
PROFILE	DOWL HKM		CABLE TV	DOWL HKM	
SANITARY SEWER	DOWL HKM		TRAFFIC SIGNAL	DOWL HKM	
STORM SEWER	DOWL HKM		DESIGN	DOWL HKM	
WATER	DOWL HKM		QUANTITIES	DOWL HKM	
GAS	DOWL HKM		MUN. FINAL CHECK	DOWL HKM	
PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
REVISIONS							

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STATE OF ALASKA 49TH Bradley M. Melocik CE 11098 REGISTERED PROFESSIONAL ENGINEER

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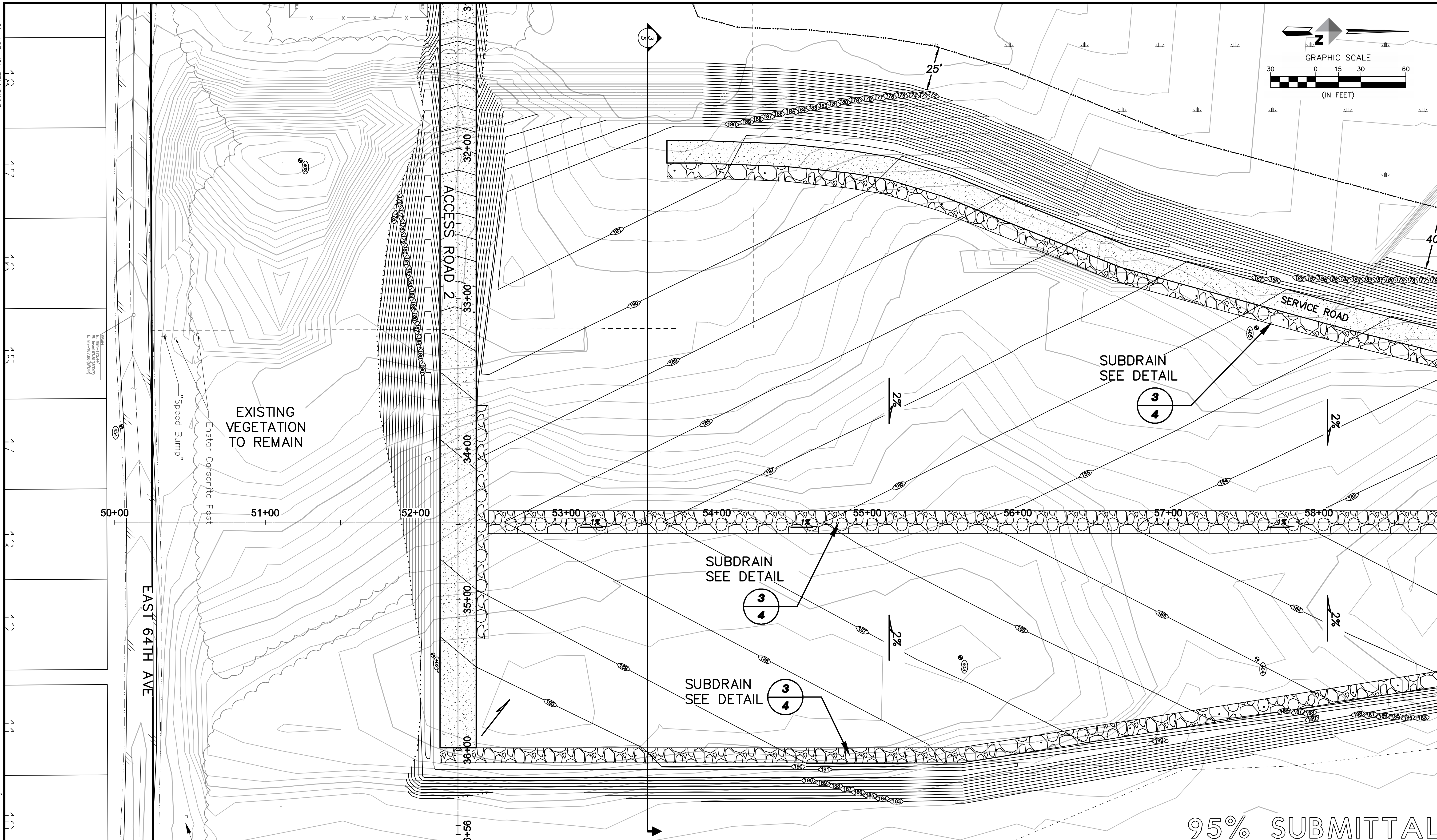
MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

04-27 DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

PROFILE & CROSS SECTIONS

SCALE: AS SHOWN | DATE 03/18/2011 | GRID 2035 | ACCT. NO. | SHEET 5 of 16



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FIELD BOOKS	BM NO.	LOCATION	ELEV.
DESIGN:			
STAKING:			
ASBUILT:			
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM		
INSPECTOR:			
CONSTRUCTION RECORD	VERTICAL DATUM		

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	DOWL HKM		TELEPHONE	DOWL HKM	
TOPOGRAPHY	DOWL HKM		ELECTRIC	DOWL HKM	
PROFILE	DOWL HKM		CABLE TV	DOWL HKM	
SANITARY SEWER	DOWL HKM		TRAFFIC SIGNAL	DOWL HKM	
STORM SEWER	DOWL HKM		DESIGN	DOWL HKM	
WATER	DOWL HKM		QUANTITIES	DOWL HKM	
GAS	DOWL HKM		MUN. FINAL CHECK	DOWL HKM	
PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
REVISIONS							

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STATE OF ALASKA 49TH REGISTERED PROFESSIONAL ENGINEER Bradley M. Melocik CE 11098

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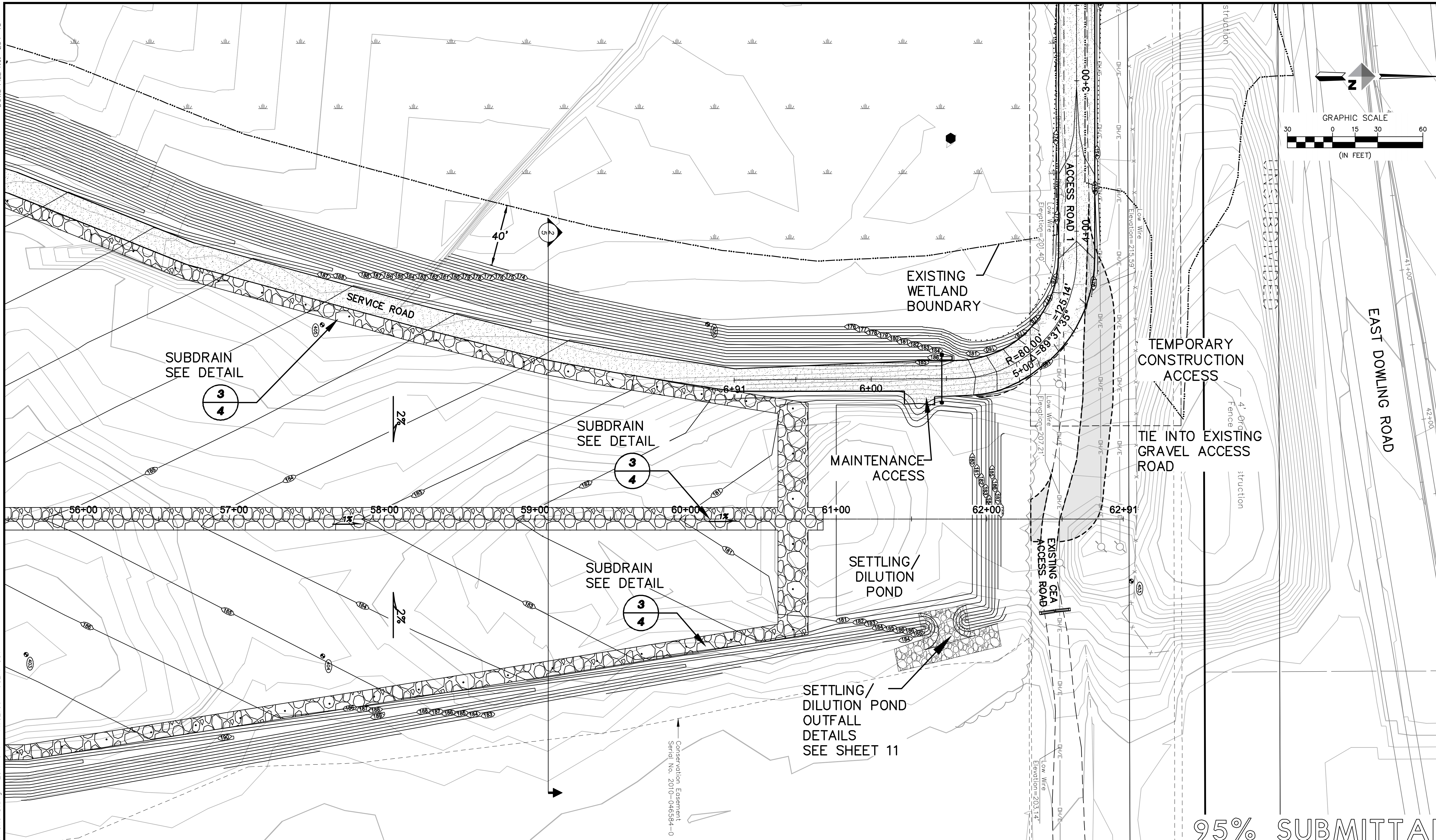
MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

04-27 DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

SITE PLAN AND GRADING

SCALE: AS SHOWN | DATE 03/18/2011 | GRID 2035 | ACCT. NO. | SHEET 6 of 16



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FIELD BOOKS	BM NO.	LOCATION	ELEV.
DESIGN:			
STAKING:			
ASBUILT:			
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM		
INSPECTOR:			
CONSTRUCTION RECORD	VERTICAL DATUM		

PLAN CHECK

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	DOWL HKM		TELEPHONE	DOWL HKM	
TOPOGRAPHY	DOWL HKM		ELECTRIC	DOWL HKM	
PROFILE	DOWL HKM		CABLE TV	DOWL HKM	
SANITARY SEWER	DOWL HKM		TRAFFIC SIGNAL	DOWL HKM	
STORM SEWER	DOWL HKM		DESIGN	DOWL HKM	
WATER	DOWL HKM		QUANTITIES	DOWL HKM	
GAS	DOWL HKM		MUN. FINAL CHECK	DOWL HKM	

REVISIONS

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY

SEAL

STATE OF ALASKA 49TH Bradley M. Melocik CE 11098 REGISTERED PROFESSIONAL ENGINEER

SEAL

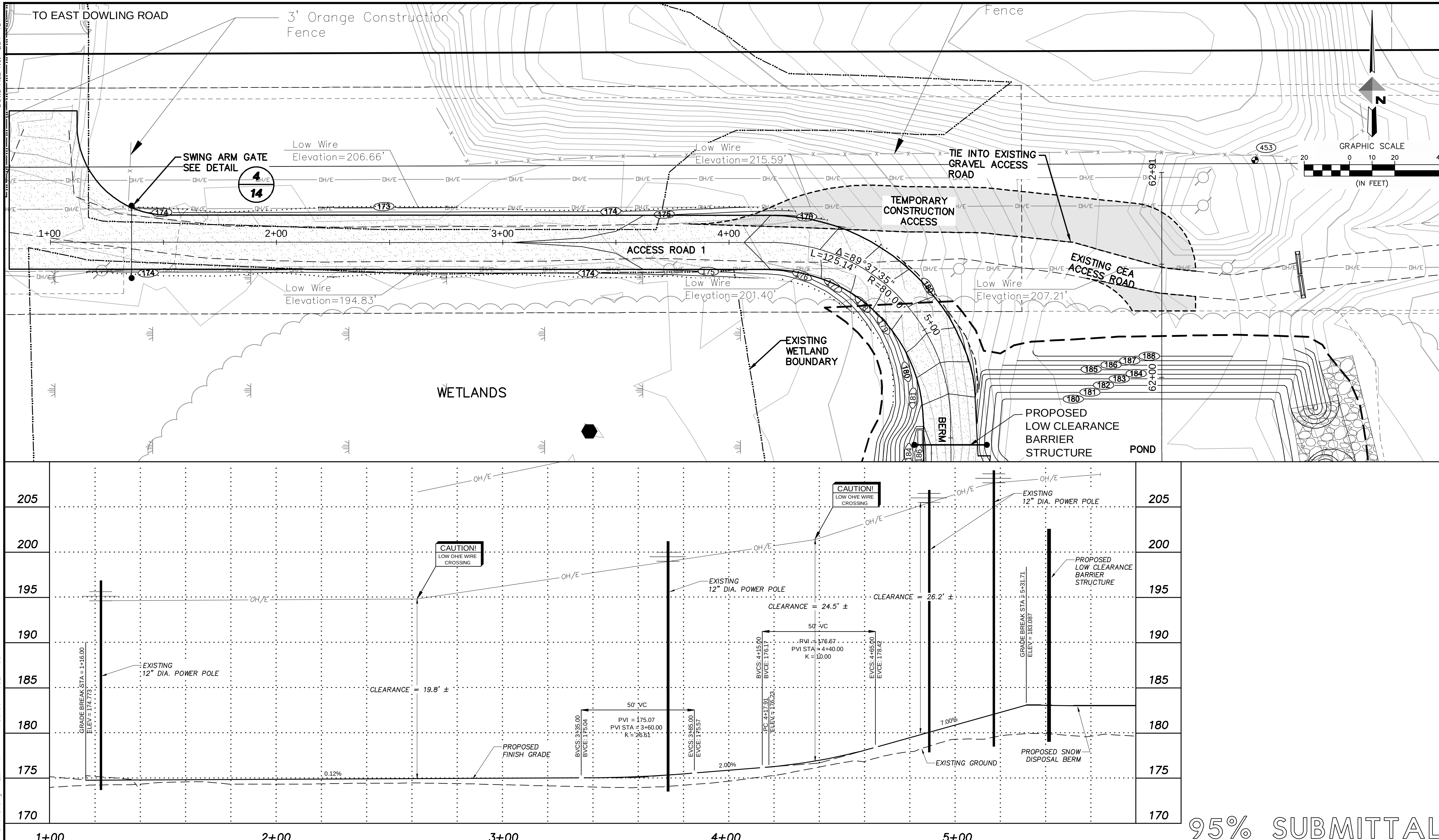
MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

04-27 DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

SITE PLAN AND GRADING

SCALE: AS SHOWN | DATE 03/18/2011 | GRID 2035 | ACCT. NO. | SHEET 7 of 16



95% SUBMITTAL

FIELD BOOKS	BM NO.	LOCATION	ELEV.
DESIGN:			
STAKING:			
ASBUILT:			
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM		
INSPECTOR:			
CONSTRUCTION RECORD	VERTICAL DATUM		

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	DOWL HKM		TELEPHONE	DOWL HKM	
TOPOGRAPHY	DOWL HKM		ELECTRIC	DOWL HKM	
PROFILE	DOWL HKM		CABLE TV	DOWL HKM	
SANITARY SEWER	DOWL HKM		TRAFFIC SIGNAL	DOWL HKM	
STORM SEWER	DOWL HKM		DESIGN	DOWL HKM	
WATER	DOWL HKM		QUANTITIES	DOWL HKM	
GAS	DOWL HKM		MUN. FINAL CHECK	DOWL HKM	
PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
REVISIONS							

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

04-27

DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

PLAN & PROFILE ACCESS ROAD 1

SCALE: AS SHOWN | DATE 03/18/2011 | GRID 2035 | ACCT. NO. | SHEET 8 of 16

DOWL FILE No: 234-43

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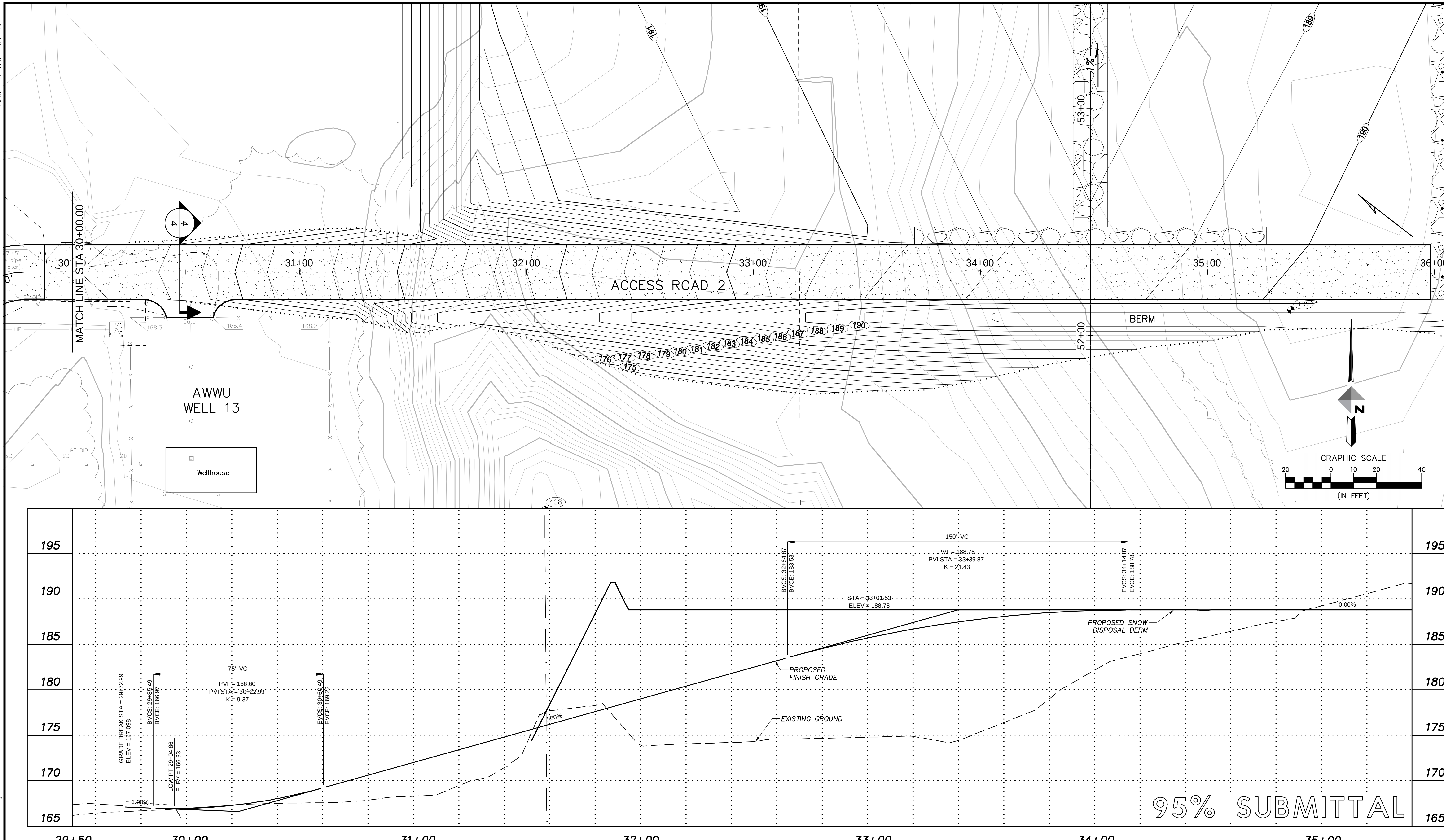

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INSPECTOR:			
CONSTRUCTION RECORD	VERTICAL DATUM		

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BASE	DOWL HKM		TELEPHONE	DOWL HKM	
TOPOGRAPHY	DOWL HKM		ELECTRIC	DOWL HKM	
PROFILE	DOWL HKM		CABLE TV	DOWL HKM	
SANITARY SEWER	DOWL HKM		TRAFFIC SIGNAL	DOWL HKM	
STORM SEWER	DOWL HKM		DESIGN	DOWL HKM	
WATER	DOWL HKM		QUANTITIES	DOWL HKM	
GAS	DOWL HKM		MUN. FINAL CHECK	DOWL HKM	
PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
REVISIONS							

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

04-27

DOWLING ROAD/SPRUCE STREET AREA
SNOW DISPOSAL SITE

PLAN & PROFILE ACCESS ROAD 2

SCALE: AS SHOWN | DATE 03/18/2011 | GRID 2035 | ACCT. NO. | SHEET 9 of 16

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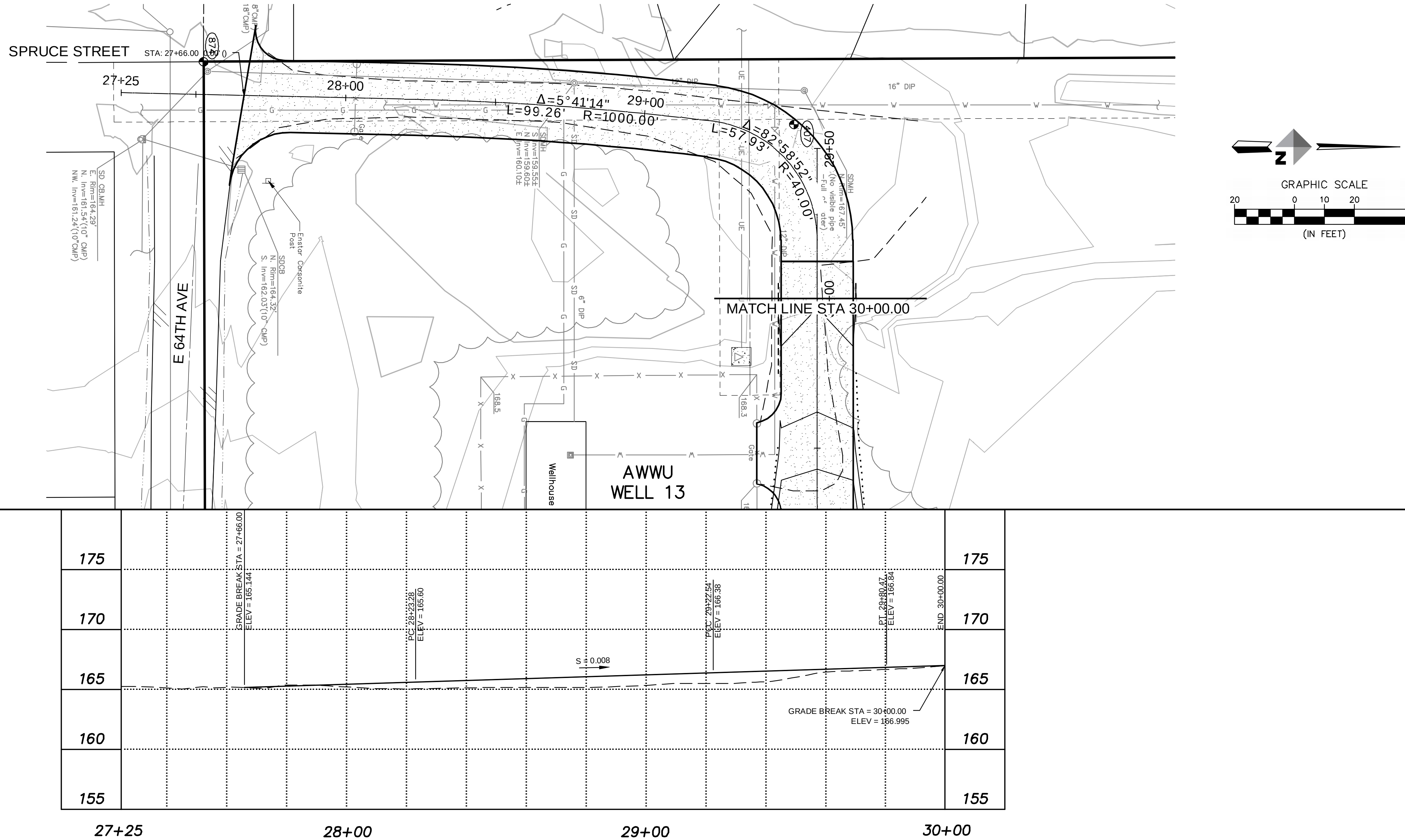

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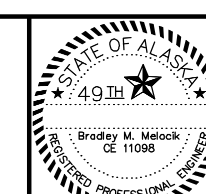

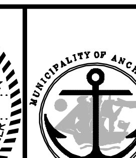

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				TOPOGRAPHY	DOWL HKM		ELECTRIC	DOWL HKM	
STAKING:				PROFILE	DOWL HKM		CABLE TV	DOWL HKM	
				SANITARY SEWER	DOWL HKM		TRAFFIC SIGNAL	DOWL HKM	
ASBUILT:				STORM SEWER	DOWL HKM		DESIGN	DOWL HKM	
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM			WATER	DOWL HKM		QUANTITIES	DOWL HKM	
INSPECTOR:				GAS	DOWL HKM		MUN. FINAL CHECK	DOWL HKM	
CONSTRUCTION RECORD	VERTICAL DATUM			PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
REVISIONS							

SEAL

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04-27

DOWLING ROAD/SPRUCE STREET AREA
SNOW DISPOSAL SITE

PLAN & PROFILE
AWWU ACCESS ROAD

SCALE: AS SHOWN	DATE 03/18/2011	GRID 2035	SHEET 10 of 16
	ACCT. NO.		

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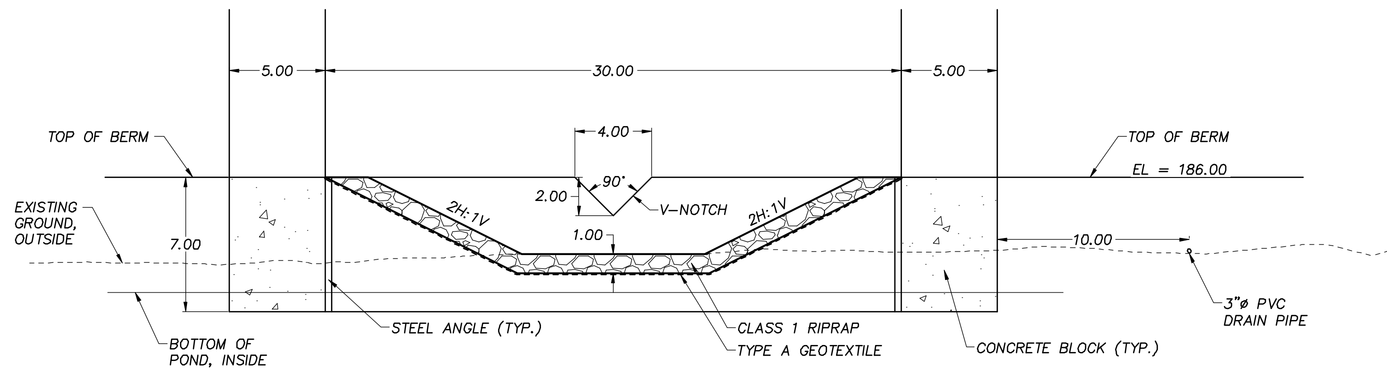
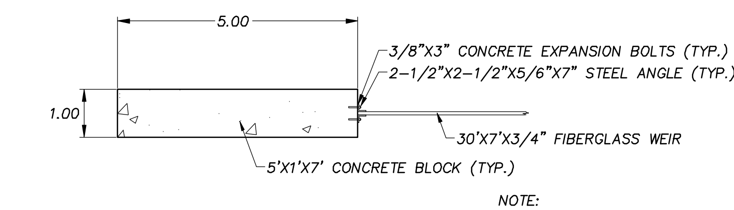
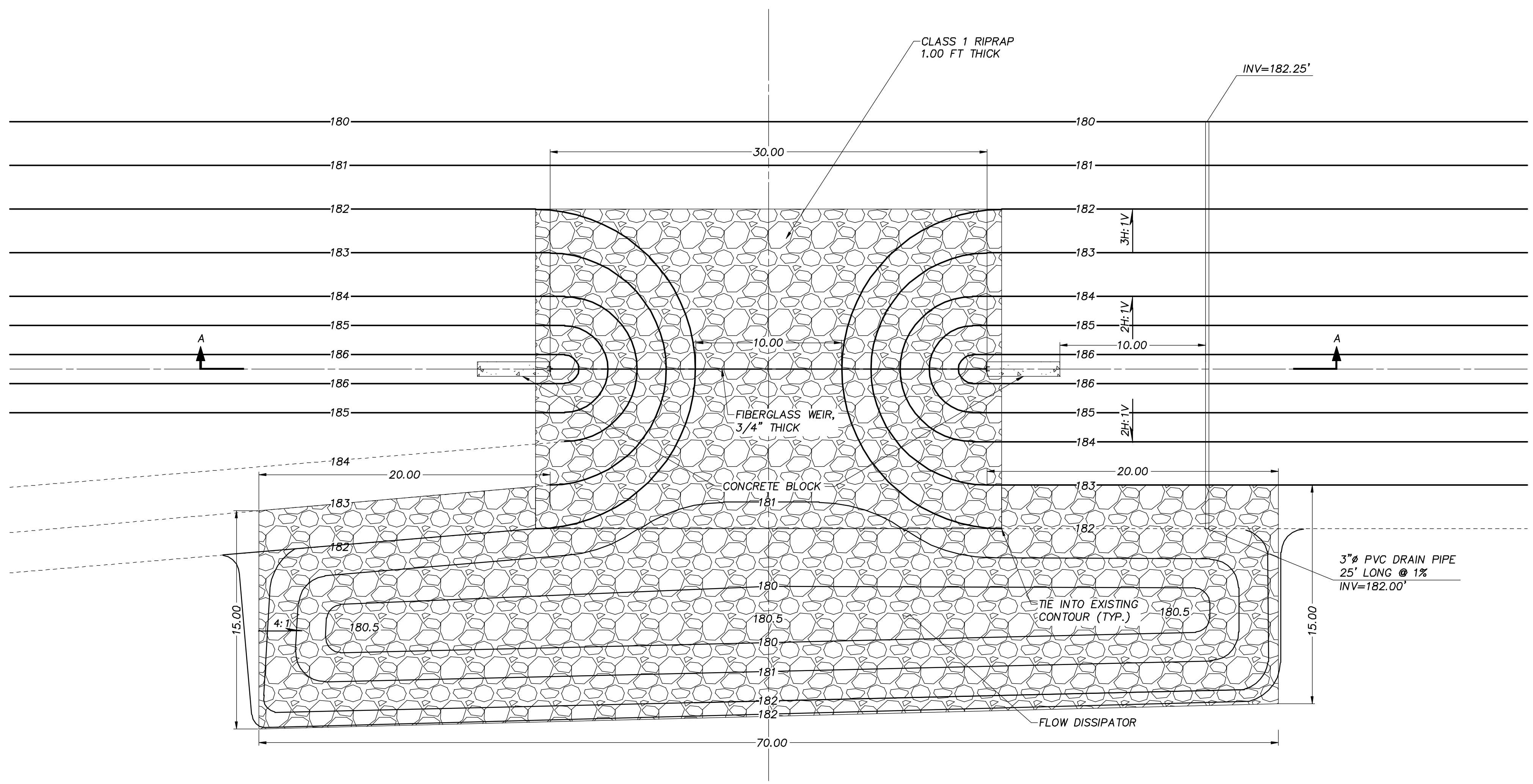


SECTION A–A



NOTE:
USE 6 CONCRETE EXPANSION BOLTS PER STEEL ANGLE SPACED VERTICALLY 12".

CLOSE UP OF WEIR–CONCRETE BLOCK CONNECTION



PLAN VIEW

1/11 DETENTION POND OUTFALL DETAILS

NTS

95% SUBMITTAL

FIELD BOOKS	BM NO.	LOCATION	ELEV.	DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
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				TOPOGRAPHY	DOWL HKM		ELECTRIC	DOWL HKM	
STAKING:				PROFILE	DOWL HKM		CABLE TV	DOWL HKM	
				SANITARY SEWER	DOWL HKM		TRAFFIC SIGNAL	DOWL HKM	
ASBUILT:				STORM SEWER	DOWL HKM		DESIGN	DOWL HKM	
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM			WATER	DOWL HKM		QUANTITIES	DOWL HKM	
INSPECTOR:				GAS	DOWL HKM		MUN. FINAL CHECK	DOWL HKM	
CONSTRUCTION RECORD	VERTICAL DATUM			PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
REVISIONS							

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STATE OF ALASKA 49TH Bradley M. Melocik CE 11098 REGISTERED PROFESSIONAL ENGINEER

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

04-27 DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

DETENTION POND OUTFALL DETAIL

SCALE: AS SHOWN | DATE 03/18/2011 | GRID 2035 | ACCT. NO. | SHEET 11 of 16

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PLANT SCHEDULE

SYMBOL	DESCRIPTION	QUANTITY	NOTES
GRASSES/SEEDLINGS/WETLAND PLUGS			
	SCHEDULE F SEED MIX (EROSION CONTROL MIX) 30% Arctared Red Fescue 40% Nortran Tufted Hairgrass 30% Nuggett Kentucky Bluegrass Application Rate: 5 lbs per 1000 sf	83,104 sf	SEE SPECS
	SEEDLINGS 50% WHITE SPRUCE *Picea glauca* 30% WHITE PAPER BIRCH *Betula papyrifera* 10% SITKA ALDER *Alnus sinuate* 10% QUAKING ASPEN *Populus tremuloides*	3,228 ea	5 FEET OC (TRIANGULAR SPACING) SEE SPECS AND DETAILS
	SOUND BARRIER FENCE	1,507 lf	SEE SPECS AND DETAILS
	CHAIN LINK SECURITY FENCE	988 lf	SEE SPECS AND DETAILS
	VEGETATION PROTECTION / SILT FENCE	2,756 lf	SEE SPECS AND DETAILS

LANDSCAPE NOTES

1. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE 2009 MUNICIPALITY OF ANCHORAGE STANDARD SPECIFICATIONS (MASS) AS CURRENTLY AMENDED UNLESS STATED OTHERWISE ON THE DRAWINGS.

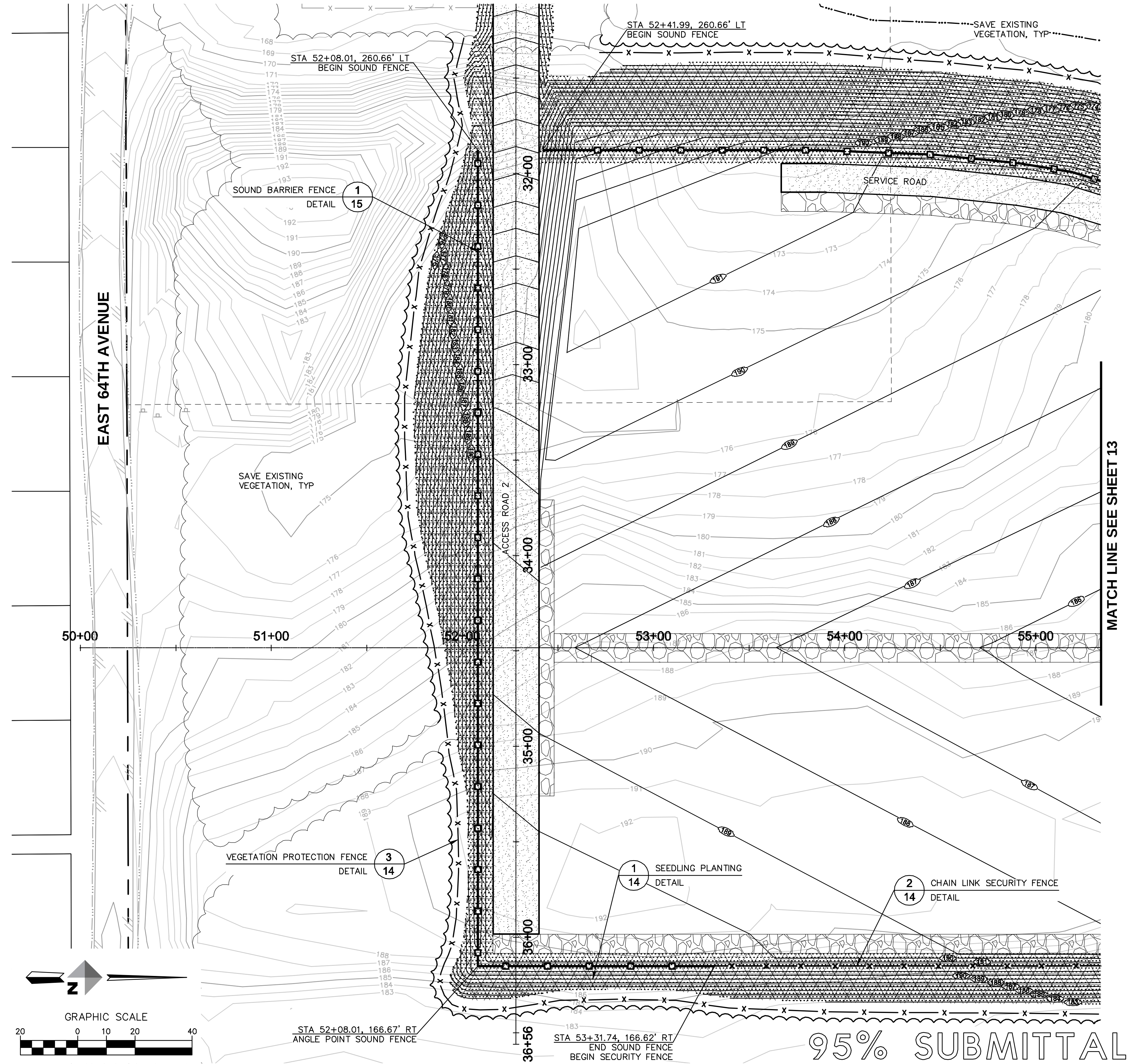
2. ALL PLANT MATERIAL SHALL CONFORM TO AMERICAN STANDARD FOR NURSERY STOCK, ANSI Z60.1-2004.

3. CONTRACTOR SHALL NOTIFY LANDSCAPE ARCHITECT ABOUT SITE CONDITIONS THAT REQUIRE MODIFICATION OF PLANT LAYOUT PRIOR TO INSTALLATION OF AFFECTED LANDSCAPE MATERIAL.

4. CONTRACTOR SHALL RESTORE ALL SURFACE DISTURBANCE RELATED TO THIS PROJECT, WITH 4" TOPSOIL AND SCHEDULE A SEED MIX.

5. CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT ALL VEGETATION DURING CONSTRUCTION OPERATIONS. ALL EXISTING LANDSCAPING WITHIN AND ADJACENT TO THE PROJECT CORRIDOR THAT IS DAMAGED BY THE CONTRACTOR SHALL BE REPLACED WITH SIMILAR SIZE AND TYPE AT THE CONTRACTOR'S EXPENSE, UNLESS OTHERWISE INDICATED BY LANDSCAPE PLANS.

6. VEGETATION PROTECTION FENCE SHALL BE INSTALLED IMMEDIATELY FOLLOWING COMPLETION OF PROJECT CLEARING TO PROTECT EXISTING VEGETATION.



FIELD BOOKS		BM NO.	LOCATION	ELEV.
DESIGN:				
STAKING:				
ASBUILT:				
CONTRACTOR:		BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM		
INSPECTOR:				
CONSTRUCTION RECORD		VERTICAL DATUM		

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	DOWL		TELEPHONE	DOWL	
TOPOGRAPHY	DOWL		ELECTRIC	DOWL	
PROFILE	DOWL		CABLE TV	DOWL	
SANITARY SEWER	DOWL		TRAFFIC SIGNAL	DOWL	
STORM SEWER	DOWL		DESIGN		
WATER	DOWL		QUANTITIES		
GAS	DOWL		MUN. FINAL CHECK		
PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
REVISIONS							

SEAL: STATE OF ALASKA 49TH — Kevin M. Doniere 10650 6/7/11 — REGISTERED PROFESSIONAL LANDSCAPE ARCHITECT

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MUNICIPALITY OF ANCHORAGE

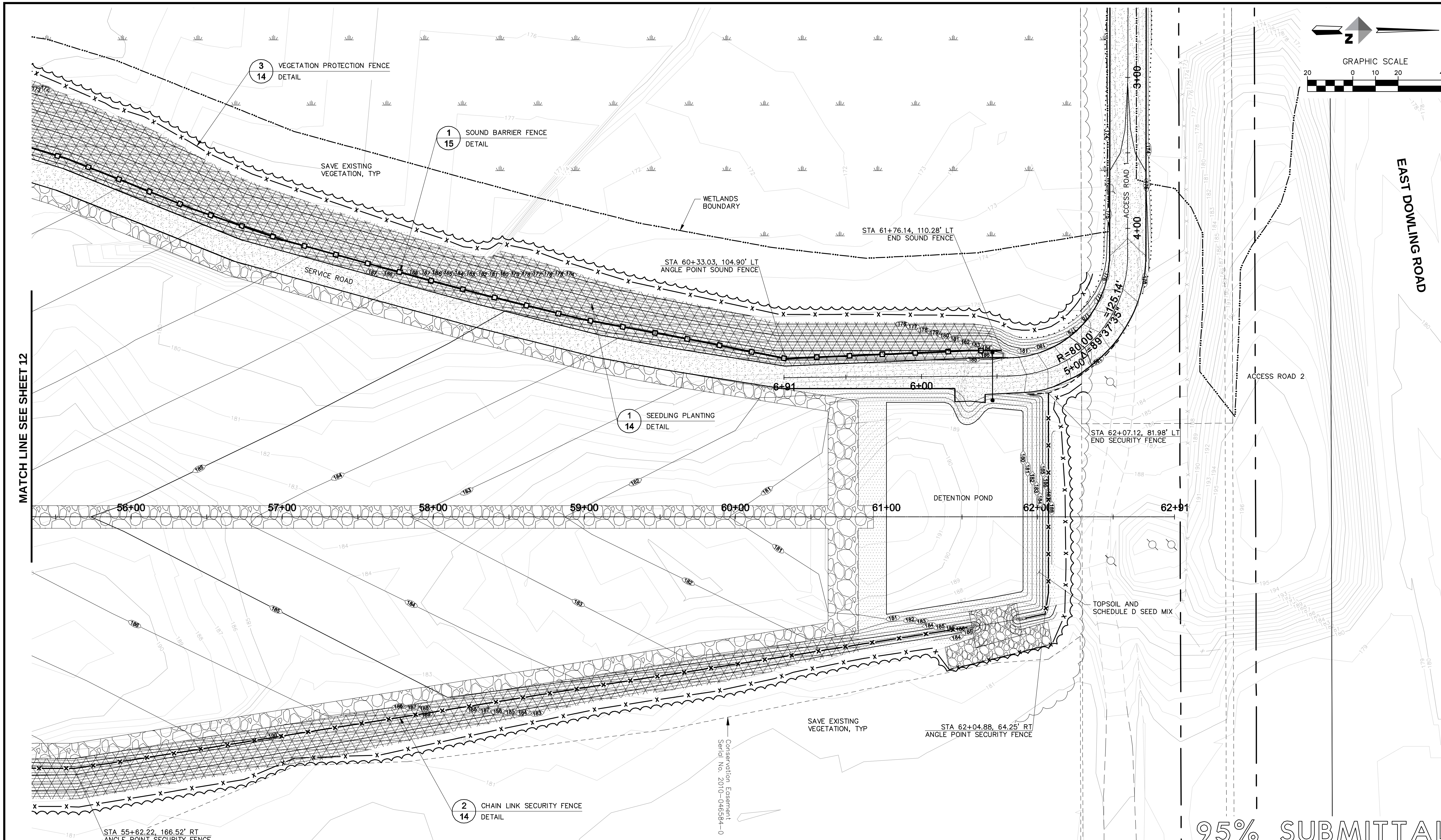
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

04-27 DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

LANDSCAPE PLAN

SCALE: AS SHOWN | DATE 06/07/2011 | GRID 2035 | ACCT. NO. | SHEET 12 of 16

FILE NO.—



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				TOPOGRAPHY	DOWL		ELECTRIC	DOWL	
STAKING:				PROFILE	DOWL		CABLE TV	DOWL	
				SANITARY SEWER	DOWL		TRAFFIC SIGNAL	DOWL	
ASBUILT:				STORM SEWER	DOWL		DESIGN		
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM			WATER	DOWL		QUANTITIES		
INSPECTOR:				GAS	DOWL		MUN. FINAL CHECK		
CONSTRUCTION RECORD	VERTICAL DATUM			PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY

REVISIONS

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

04-27 DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

LANDSCAPE PLAN

SCALE: AS SHOWN | DATE 06/07/2011 | GRID 2035 | ACCT. NO. | SHEET 13 of 16

FILE NO.—

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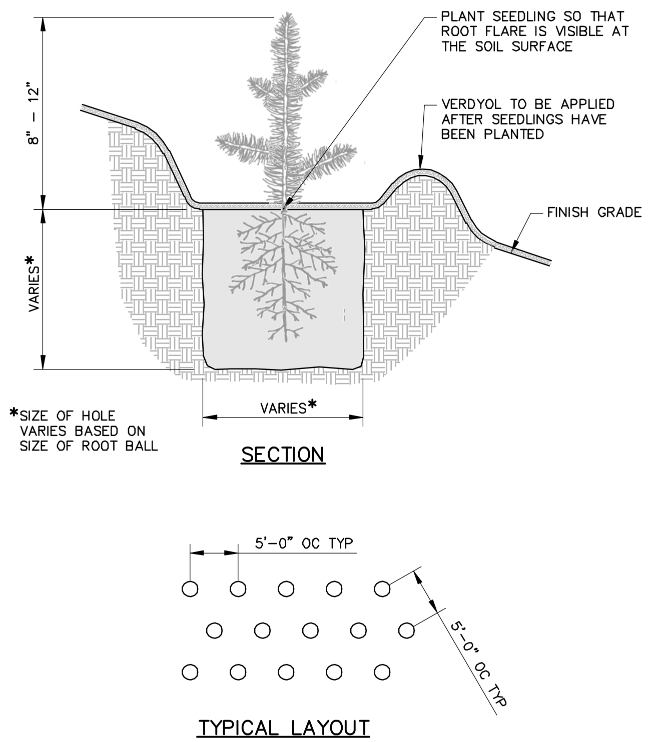
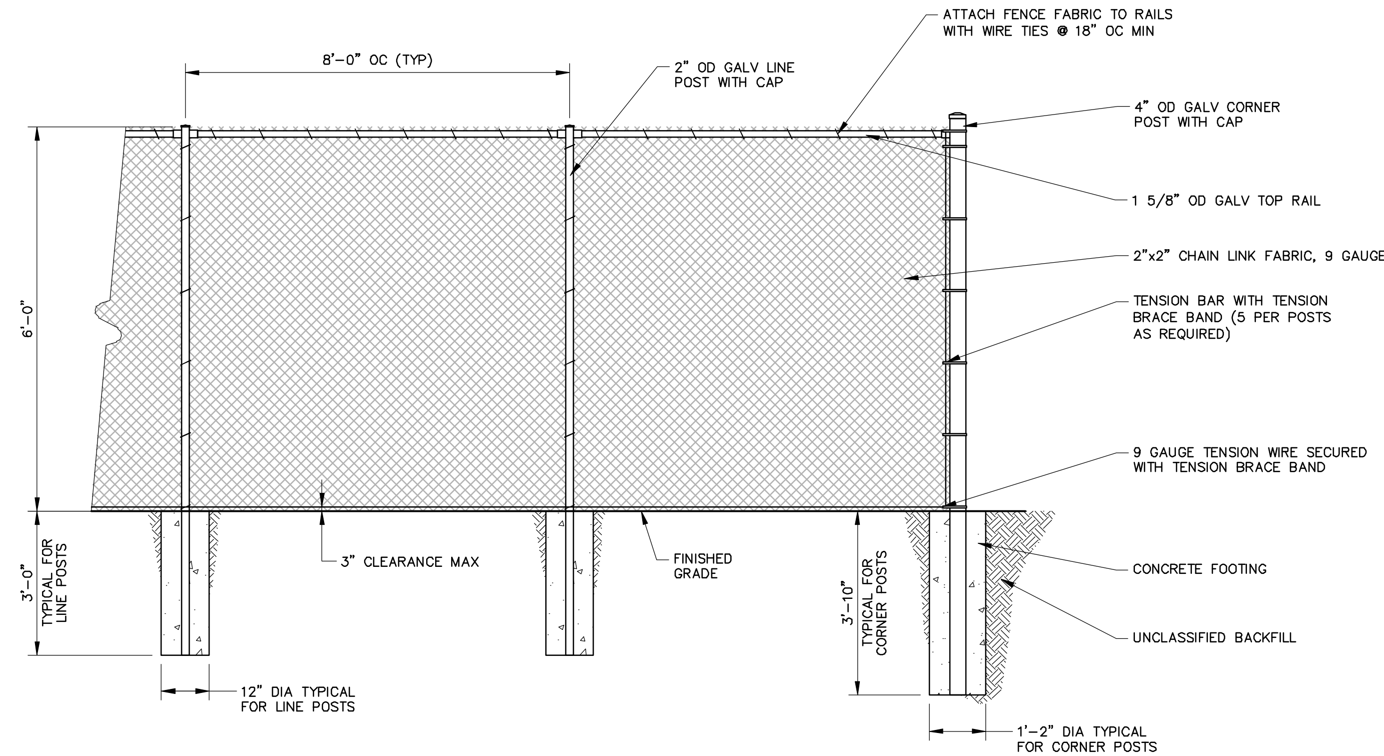
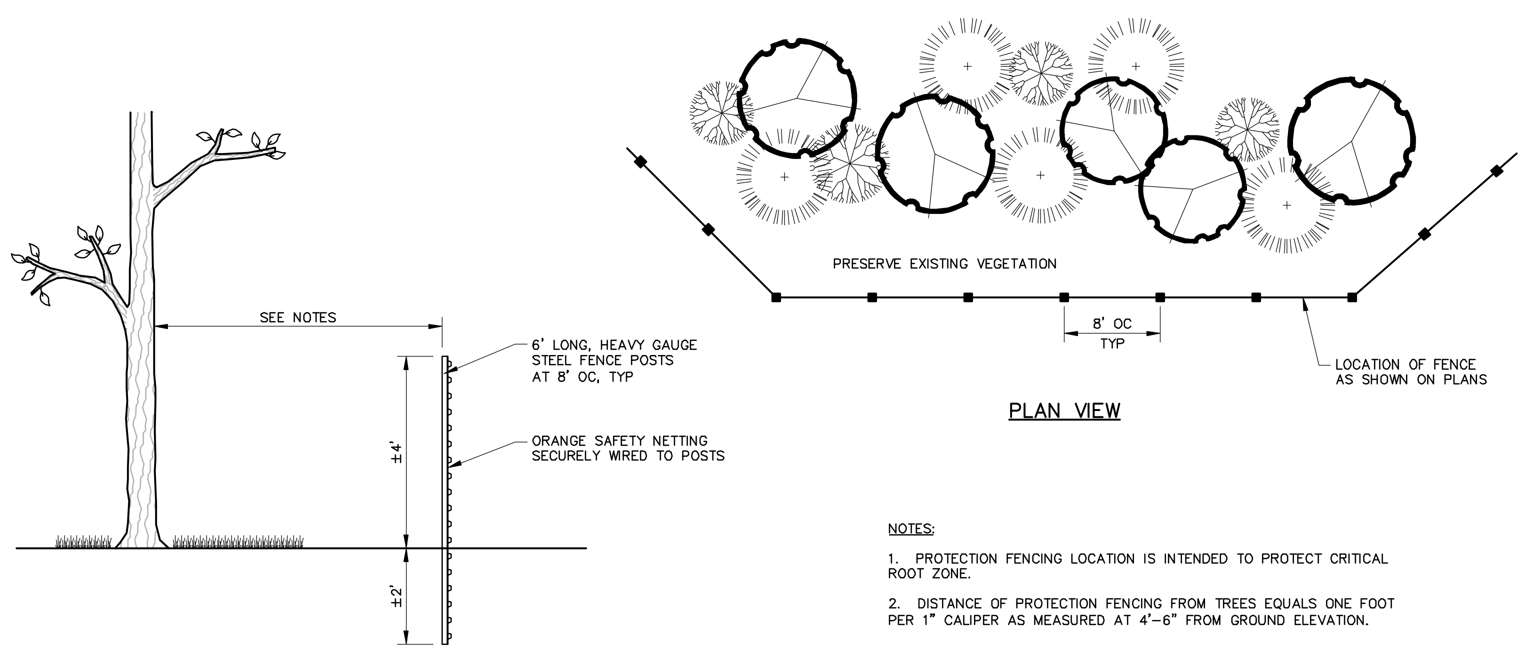


1/14 SEEDLING PLANTING DETAIL
NTS



2/14 CHAIN LINK SECURITY FENCE
NTS

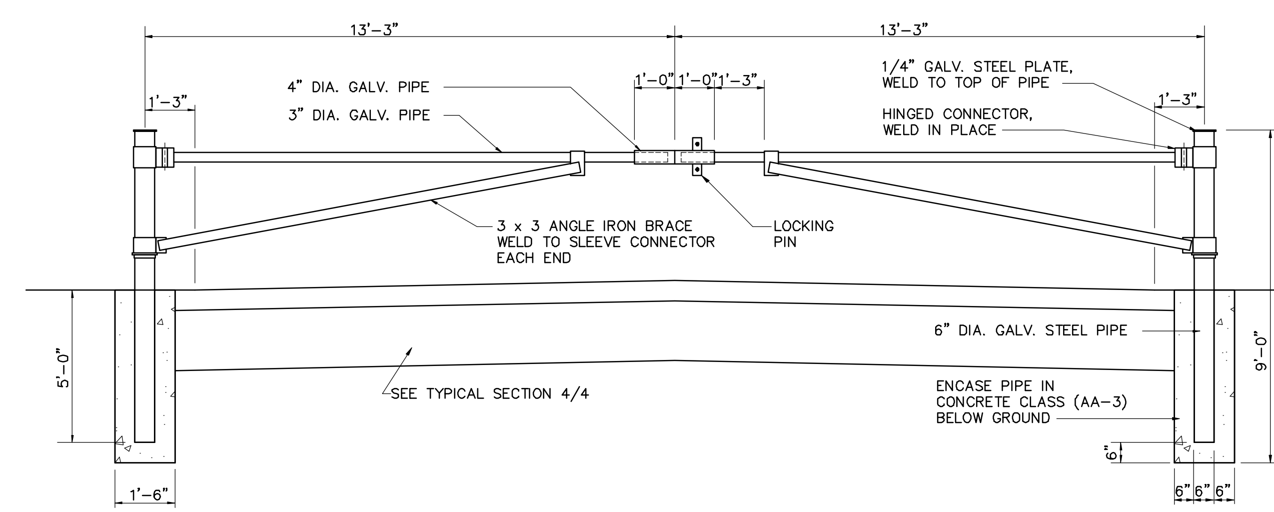


NOTES:

1. PROTECTION FENCING LOCATION IS INTENDED TO PROTECT CRITICAL ROOT ZONE.

2. DISTANCE OF PROTECTION FENCING FROM TREES EQUALS ONE FOOT PER 1" CALIPER AS MEASURED AT 4'-6" FROM GROUND ELEVATION.

3/14 TEMPORARY PROTECTION FENCE FOR EXISTING VEGETATION
NTS



4/14 SWING ARM GATE
NTS

95% SUBMITTAL

FIELD BOOKS	BM NO.	LOCATION	ELEV.	DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
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STAKING:				TOPOGRAPHY	DOWL		ELECTRIC	DOWL	
				PROFILE	DOWL		CABLE TV	DOWL	
ASBUILT:				SANITARY SEWER	DOWL		TRAFFIC SIGNAL	DOWL	
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM			STORM SEWER	DOWL		DESIGN		
INSPECTOR:				WATER	DOWL		QUANTITIES		
				GAS	DOWL		MUN. FINAL CHECK		
CONSTRUCTION RECORD	VERTICAL DATUM			PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
REVISIONS							

STATE OF ALASKA 49TH Kevin M. Doniere 10650 6/7/11 REGISTERED PROFESSIONAL LANDSCAPE ARCHITECT

SEAL | SEAL

MUNICIPALITY OF ANCHORAGE

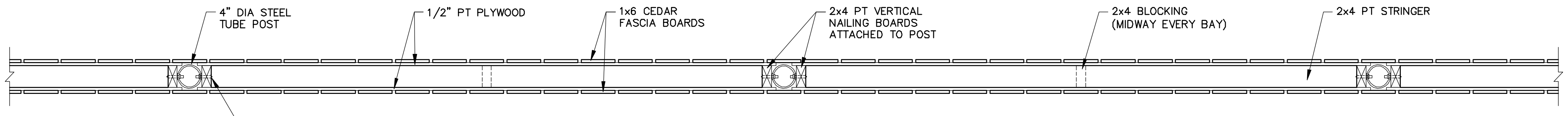
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

04-27 DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

LANDSCAPE DETAILS

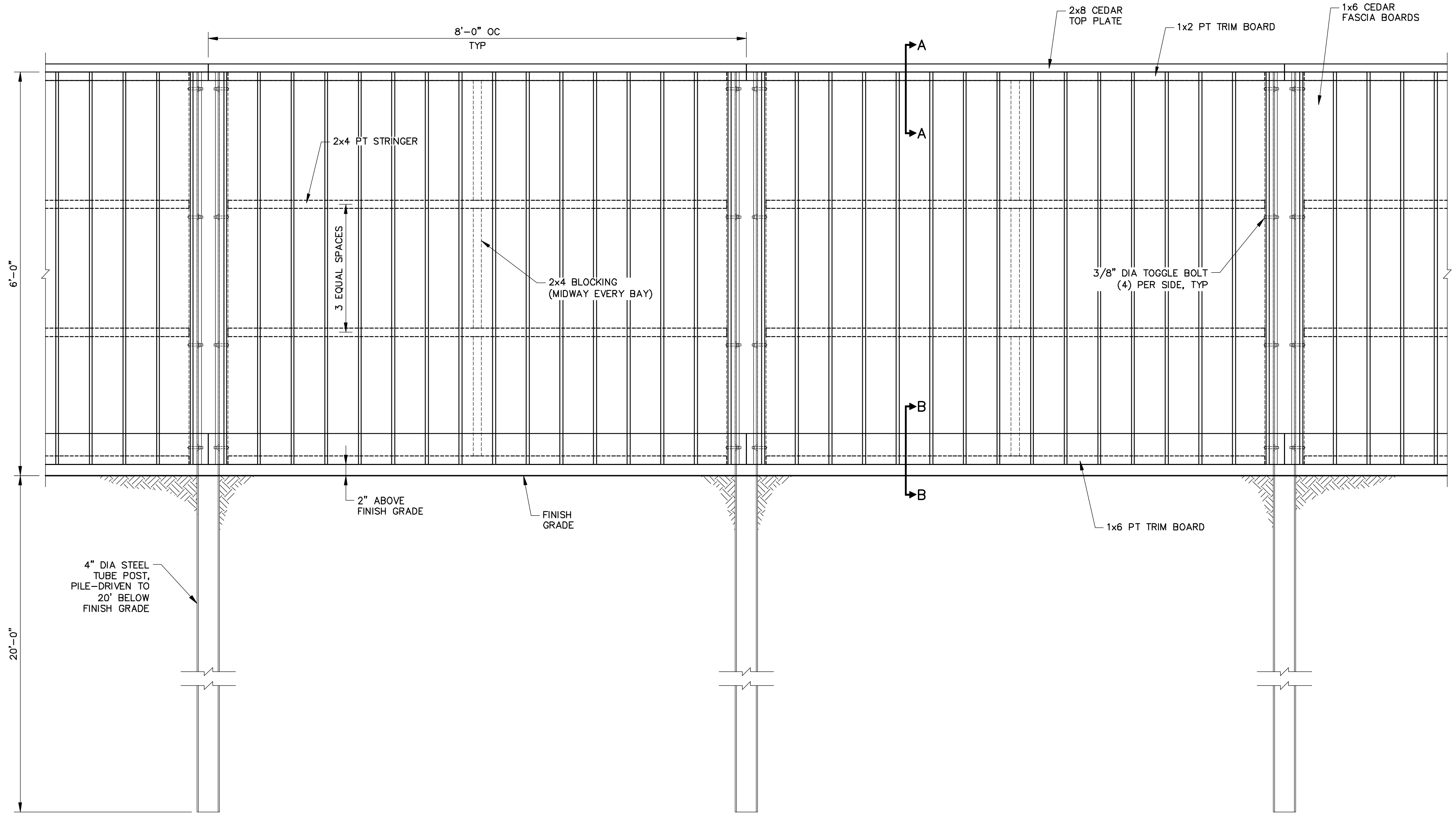
SCALE: AS SHOWN | DATE 06/07/2011 | GRID 2035 | ACCT. NO. | SHEET 14 of 16

FILE NO.—



TOP VIEW

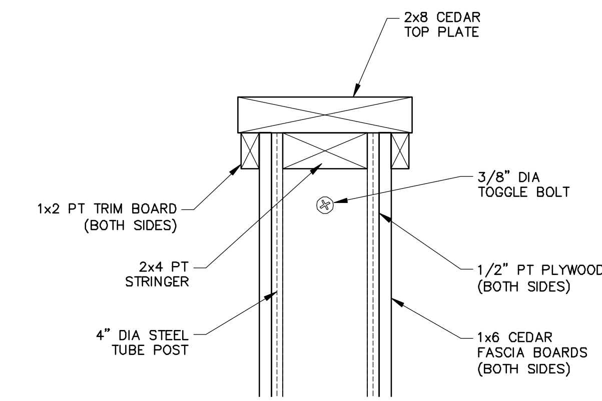
(TOP PLATE OMITTED IN THIS VIEW FOR CLARITY)



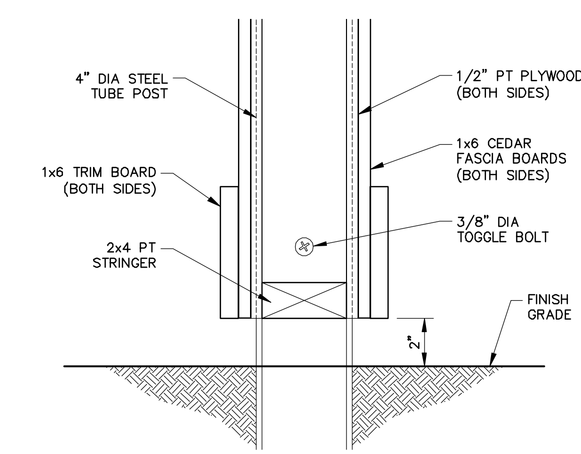
ELEVATION

SOUND BARRIER FENCE NOTES:

1. POSTS SHALL BE HIGH STRENGTH 4" DIAMETER STEEL TUBES, 1/4" THICK, ASTM A500 GRADE B.
2. INSTALL POSTS AT ALL ANGLE POINTS. MAXIMUM SPACING OF POSTS IS 8' OC. POSTS SHALL BE SET PLUMB.
3. ATTACH VERTICAL NAILING BOARD TO POST USING 3/8" DIA TOGGLE BOLTS.
4. ATTACH STRINGERS TO VERTICAL NAILING BOARDS WITH SIMPSON STRONGTIE FENCE BRACKETS (FB24) AT EACH END, INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.
5. ALL STEEL SHALL BE HOT DIP GALVANIZED, INCLUDING ALL NAILS AND HARDWARE.
6. CEDAR FASCIA BOARDS AND CEDAR TOP PLATE TO BE STAINED (SEE SPECS).
7. FRAMING AND PLYWOOD TO BE PRESSURE TREATED.
8. GRADING OF LUMBER SHALL BE AS STATED IN TIMBER CONSTRUCTION MANUAL, 2ND EDITION AMERICAN INSTITUTE OF TIMBER CONSTRUCTION FOR DOUGLAS FIR-LARCH. STRINGERS SHALL BE GRADED NO. 2 OR BETTER.
9. TOP AND BOTTOM OF FENCE SHALL FOLLOW FINISH GRADE.



SECTION A–A



SECTION B–B

1/15 SOUND BARRIER FENCE

NTS

95% SUBMITTAL

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STAKING:				TOPOGRAPHY	DOWL		ELECTRIC	DOWL	
				PROFILE	DOWL		CABLE TV	DOWL	
ASBUILT:				SANITARY SEWER	DOWL		TRAFFIC SIGNAL	DOWL	
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM			STORM SEWER	DOWL		DESIGN		
INSPECTOR:				WATER	DOWL		QUANTITIES		
				GAS	DOWL		MUN. FINAL CHECK		
CONSTRUCTION RECORD	VERTICAL DATUM			PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
REVISIONS							

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04-27 DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

SOUND FENCE DETAILS

SCALE: AS SHOWN | DATE 06/07/2011 | GRID 2035 | ACCT. NO. | SHEET 15 of 16

FILE NO.–

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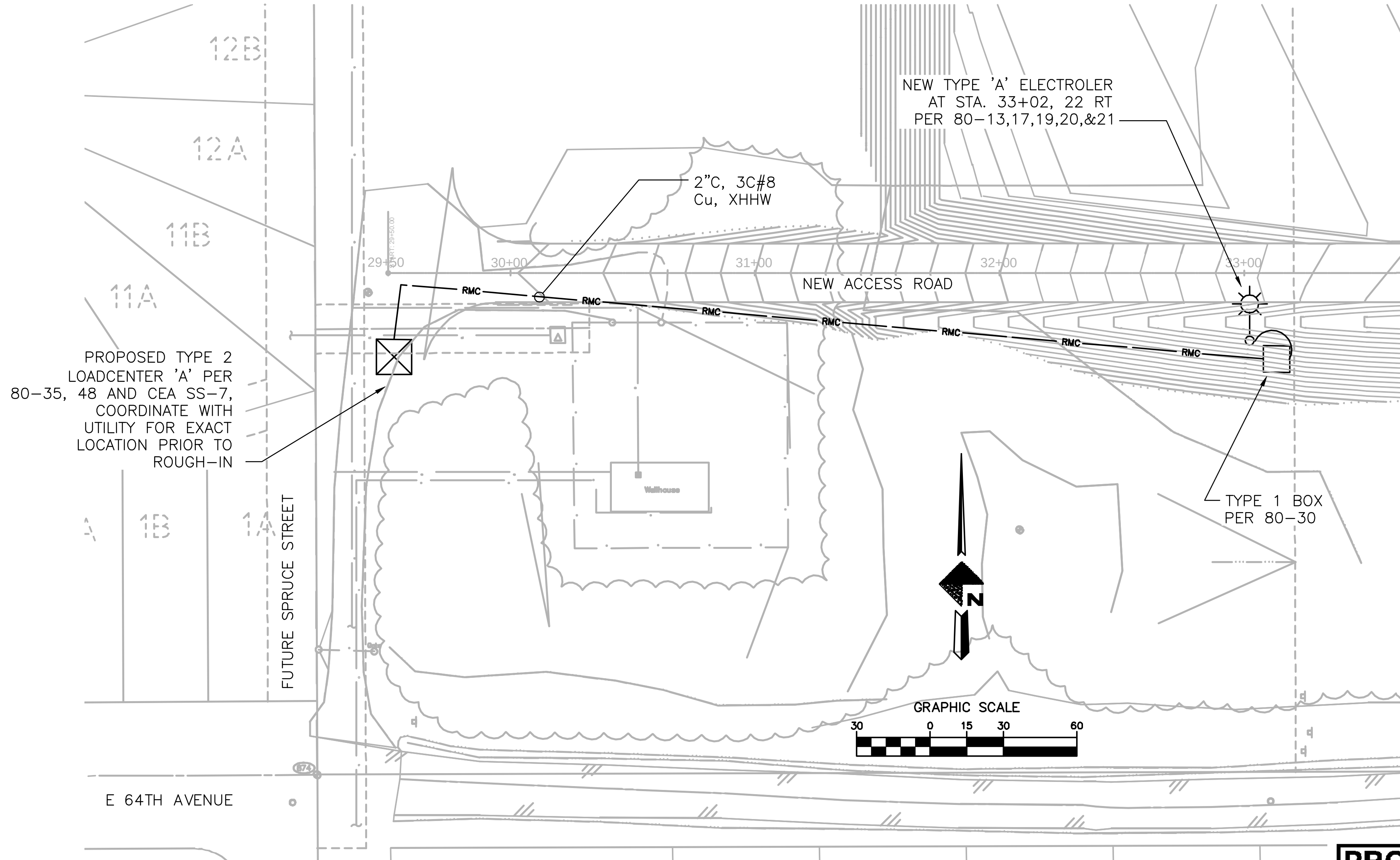


1/16 ILLUMINATION PLAN

ROADWAY ILLUMINATION HAS BEEN DESIGNED IN ACCORDANCE WITH THE MARCH 2007 MUNICIPALITY OF ANCHORAGE PM&E DESIGN CRITERIA MANUAL CHAPTER 2 RECOMMENDATIONS FOR SNOW STORAGE ILLUMINATION. IN ADDITION, IESNA RP–8 AND AASHTO IGRL LUMINAIRE PERFORMANCE CRITERIA, RECOMMENDATIONS FOR LUMINANCE, UNIFORMITY, AND REDUCTION OF GLARE TO MOTORISTS BASED ON A LOCAL RESIDENTIAL CLASSIFICATION WITH R3 PAVEMENT AND LOW PEDESTRIAN CONFLICTS HAVE BEEN INCORPORATED INTO THE DESIGN.

SYMBOL LEGEND

- ELECTROLIER
- LOADCENTER
- TYPE 1 JUNCTION BOX
- RMC — RIGID METALLIC CONDUIT (GALVANIZED)

NOTES:

1. ALL WORK SHALL CONFORM TO NEC REQUIREMENTS AND THE MOST RECENTLY ADOPTED MUNICIPALITY OF ANCHORAGE STANDARD SPECIFICATIONS (MASS) AND DETAILS, INCLUDING ALL SPECIAL PROVISIONS.
2. ALL POLES AND BOXES SHALL BE A MINIMUM OF 7FT FROM THE EDGE OF TRAVELLED WAY UNLESS DIRECTED OTHERWISE BY ENGINEER IN THE FIELD.
3. FUSED SPLICE LOCATIONS FOR ILLUMINATION CIRCUIT SHALL BE IN POLE BASE PER MASS SECTION 80.12 AND PM&E DCM SECTION 5.8.
4. CONDUIT ROUTING SHOWN IS DIAGRAMMATIC, ALL ROAD CROSSINGS SHALL BE PERPENDICULAR TO CENTERLINE OF ROADWAY UNLESS DIRECTED OTHERWISE BY OWNER'S REPRESENTATIVE. ALL WORK SHALL BE PERFORMED WITHIN THE RIGHT OF WAY.
5. PROVIDE HAND–OFF–AUTO CONTROL SWITCH WITHIN LOADCENTER ENCLOSURE FOR MANUAL CONTROL OF ELECTROLIER BY FACILITY PERSONNEL.

BEFORE YOU DIG CALL FOR FREE UNDERGROUND LOCATION

Locate Call Center of Alaska
Anchorage Area..................278–3121
Statewide...................800–478–3121
who will notify subscribed utilities only. Other utilities need to be contacted individually.

ELECTROLIER SCHEDULE

DESIG-NATION	MFR'S PRODUCT # OR APP. EQUAL	PRODUCT DESCRIPTION	DIODE QTY.	WATTS	TYPE	LOCATION & MOUNTING
A	BETALED # STR-LWY-3M-AA-03-D-UL-SV-700-IP-43K-PD-SC-XA-BRDSPK30	LED AREA LUMINAIRE, DIE-CAST ALUMINUM HOUSING, TYPE III DISTRIBUTION, UNIVERSAL VOLTAGE 700mA SOLID STATE DRIVER, ADJUSTABLE ARM MOUNT, 6FT MAST ARM, 4300 DEG. K, POWER DOOR, SAFETY TETHER, SILVER FINISH, BIRD SPIKE ACCESSORY.	30	77	LIGHT EMITTING DIODE	ROUND GALVANIZED TAPERED STEEL POLE @ 30 FT ON SLIP PILE BASE

PROPOSED LOADCENTER 'A' - MOA TYPE 2

COOPER B-LINE #CMP4121MC 120/240V,1-PH,3W POST MTD. 200A
VOLT-AMPS MBR

CIRC	POLE	AMPS	SERVICE	NOTES	A	B	NOTES	SERVICE	AMPS	POLE	CIRC
1		200	MAIN		39		A	GATE ILLUMINATION	20		2
3	2					39	A			2	4
5	1	-	SPACE					CONTROLS	15	1	6
7	|	|	|					SPARE	20		8
9	|	|	|							2	10
11	|	|	|					SPACE	-	1	12
			TOTAL V-A		39	39		78 VA			
			TOTAL AMPS		0	0		0.33 A			
			A.I.C. RATING: 14,000								

LOAD CENTER TYPE: 2
SERVING UTILITY: CEA
LOCATION: STA. 29+50., 35RT
PHOTOELECTRIC CONTROL: PERISCOPE
CONTACTOR RATING: 30A

A LOAD SERVED VIA PHOTOCELL CONTROL

95% SUBMITTAL

FIELD BOOKS	BM NO.	LOCATION	ELEV.	DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
DESIGN:				BASE	DOWL HKM		TELEPHONE	DOWL HKM	
				TOPOGRAPHY	DOWL HKM		ELECTRIC	DOWL HKM	
STAKING:				PROFILE	DOWL HKM		CABLE TV	DOWL HKM	
				SANITARY SEWER	DOWL HKM		TRAFFIC SIGNAL	DOWL HKM	
ASBUILT:				STORM SEWER	DOWL HKM		DESIGN	DOWL HKM	
CONTRACTOR:	BASIS OF DATUM: 1972 N.G.S. ADJUSTED DATUM			WATER	DOWL HKM		QUANTITIES	DOWL HKM	
INSPECTOR:				GAS	DOWL HKM		MUN. FINAL CHECK	DOWL HKM	
CONSTRUCTION RECORD	VERTICAL DATUM			PLAN CHECK					

REV	DATE	DESCRIPTION	BY	REV	DATE	DESCRIPTION	BY
REVISIONS							

SEAL

RSA
Mechanical and Electrical Consulting Engineers
2522 Arctic Boulevard Anchorage, AK 99503 (907) 276-0521
191 Swanson Avenue Wasilla, Alaska 99654 (907) 357-1521

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

04–27 DOWLING ROAD/SPRUCE STREET AREA SNOW DISPOSAL SITE

ILLUMINATION PLAN AND SCHEDULES

SCALE: AS SHOWN DATE 06/01/2011 GRID 2035 ACCT. NO. SHEET 16 of 16

ANCHORAGE SNOW DISPOSAL SITES:
2013 EVALUATION

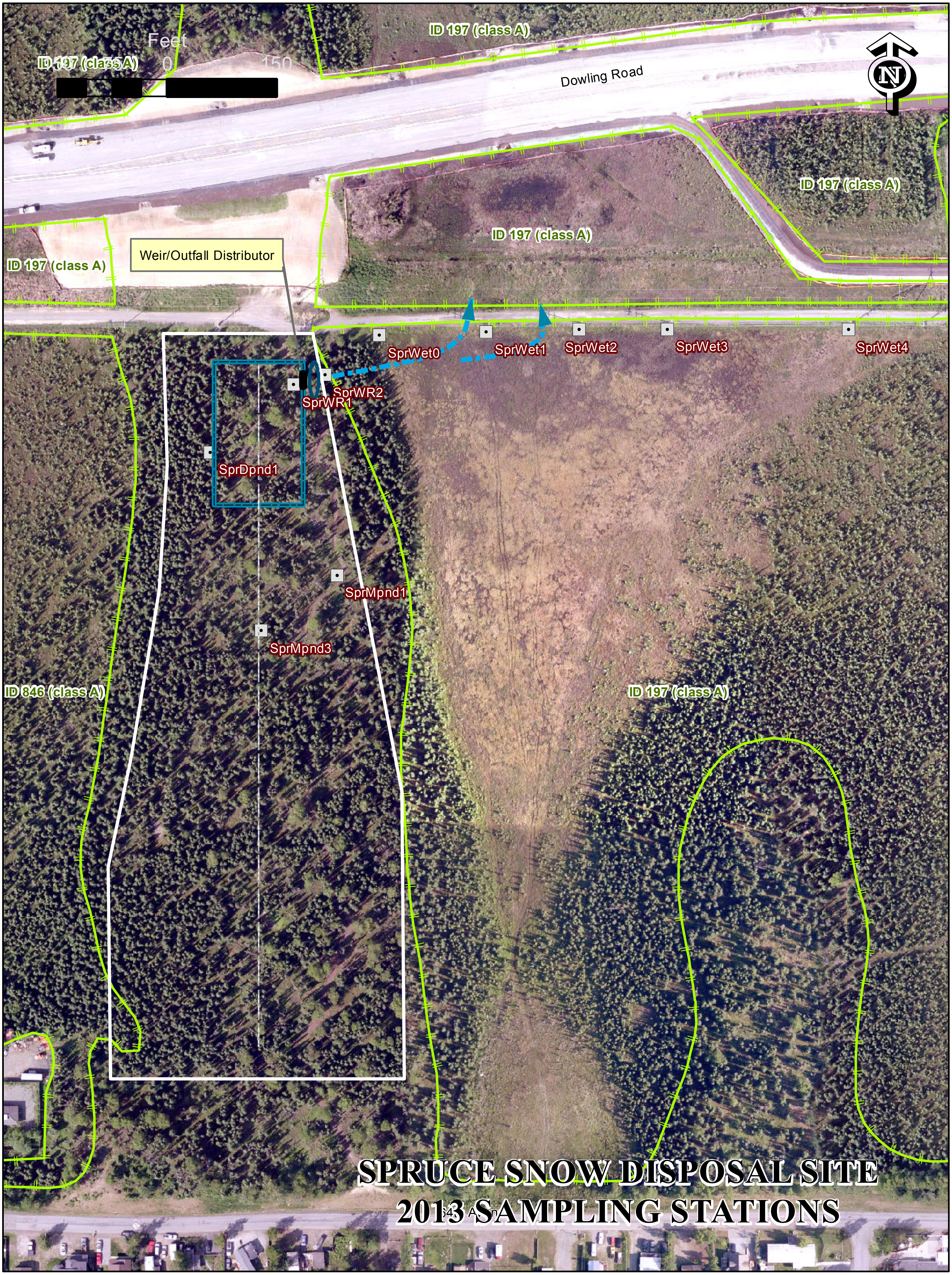
Document No.: WMP ARr14002
WMS Project No.: 95004

Appendix C – 2013 V-Swale Sampling Stations

Contents:

1. Tudor Snow Disposal Site
2. Spruce Street Snow Disposal Site

SCH-10
Mc Lean Place
Tudor Road
Baxter Road
Campbell Airstrip Road
N
TdrOF
TdrOut
TdrDpnd1
TdrWR2
TdrWR3
TdrWR1
ID 197 (class A)
Feet
150 75 0 150
TUDOR SNOW DISPOSAL SITE
2013 SAMPLING STATIONS



ID 197 (class A)
Feet
0
150
ID 197 (class A)
Dowling Road
N
ID 197 (class A)
ID 197 (class A)
Weir/Outfall Distributor
ID 197 (class A)
SprWet0
SprWet1
SprWet2
SprWet3
SprWet4
SprWR2
SprWR1
SprDpnd1
SprMpnd1
SprMpnd3
ID 846 (class A)
ID 197 (class A)
SPRUCE SNOW DISPOSAL SITE
2013 SAMPLING STATIONS

ANCHORAGE SNOW DISPOSAL SITES:
2013 EVALUATION

Document No.: WMP ARr14002
WMS Project No.: 95004

Appendix D – 2013 V-Swale Data Summaries

Contents:

1. Laboratory Samples List
2. Laboratory Test Reports
3. Lab-Field Correlations
4. Small Sample Population Analysis
5. Turbidity Time Series
6. Chloride Time Series
7. pH Time Series

2013 V-Swale Evaluation: Samples

SampID	SampDate	SampTime	Matrix	StnID
A1305190-01	5/10/2013	1/0/1900	snowmelt	Tdr_OF
A1305190-02	5/10/2013	1/0/1900	snowmelt	Tdr_Wr1
A1305190-03	5/10/2013	1/0/1900	snowmelt	Spr_Wr2
A1305207-01	5/13/2013	1/0/1900	snowmelt	Tdr_Wr1
A1305207-02	5/13/2013	1/0/1900	snowmelt	Tdr_Wr3
A1305207-03	5/13/2013	1/0/1900	snowmelt	Spr_Wr1
A1305306-01	5/16/2013	1/0/1900	snowmelt	Tdr_Wr1
A1305306-02	5/16/2013	1/0/1900	snowmelt	Spr_Wr1
A1305306-03	5/16/2013	1/0/1900	snowmelt	Spr_Wr2
A1305394-01	5/23/2013	1/0/1900	snowmelt	Tdr_Mpnd1
A1305394-02	5/23/2013	1/0/1900	snowmelt	Tdr_Wr1
A1305394-03	5/23/2013	1/0/1900	snowmelt	Tdr_Dpnd1
A1305394-04	5/23/2013	1/0/1900	snowmelt	Spr_Wr2
A1305486-01	5/30/2013	1/0/1900	stream water	Tdr_Strm
A1305486-02	5/30/2013	1/0/1900	snowmelt	Tdr_Wr1
A1305486-03	5/30/2013	1/0/1900	snowmelt	Spr_Wr1
A1305486-04	5/30/2013	1/0/1900	snowmelt	Spr_Wr2
A1306138-01	6/6/2013	1/0/1900	snowmelt	Tdr_Wr1
A1306138-02	6/6/2013	1/0/1900	snowmelt	Spr_Wr2
A1306246-01	6/13/2013	1/0/1900	snowmelt	Tdr_Wr1
A1306246-02	6/13/2013	1/0/1900	snowmelt	Spr_Wr2
A1306354_01	6/20/2013	1/0/1900	snowmelt	Tdr_Wr1
A1306354_02	6/20/2013	1/0/1900	snowmelt	Spr_Wr2
A1306476-01	6/27/2013	1/0/1900	stream water	Tdr_Strm
A1306476-02	6/27/2013	1/0/1900	snowmelt	Tdr_Wr1
A1306476-03	6/27/2013	1/0/1900	snowmelt	Spr_Wr2
A1306476-04	6/27/2013	1/0/1900	snowmelt	Spr_Dpnd1
A1307115-01	7/5/2013	1/0/1900	snowmelt	Tdr_Wr1
A1307115-02	7/5/2013	1/0/1900	snowmelt	Spr_Wr1
f1-130523-01	5/23/2013	1/0/1900	snowmelt	Spr_Wr1
f1-130528-01	5/28/2013	1/0/1900	snowmelt	Spr_Wr2

2013 V-Swale Evaluation: Samples				
SampID	**SampDate**	**SampTime**	**Matrix**	**StnID**
f1-130528-02	5/28/2013	1/0/1900	snowmelt	Spr_Mpnd1
f1-130528-03	5/28/2013	1/0/1900	snowmelt	Spr_Mpnd2
f1-130528-04	5/28/2013	1/0/1900	snowmelt	Spr_Mpnd3
f1-130606-01	6/6/2013	1/0/1900	snowmelt	Spr_Wr1
f1-130606-02	6/6/2013	1/0/1900	wetland pool	Spr_Wet0
f1-130613-01	6/13/2013	1/0/1900	wetland pool	Spr_Wet0
f1-130613-02	6/13/2013	1/0/1900	wetland pool	Spr_Wet1
f1-130613-03	6/13/2013	1/0/1900	wetland pool	Spr_Wet2
f1-130613-04	6/13/2013	1/0/1900	wetland pool	Spr_Wet3
f1-130613-05	6/13/2013	1/0/1900	wetland pool	Spr_Wet4
f1-130620-01	6/20/2013	1/0/1900	wetland pool	Spr_Wet0
f1-130620-02	6/20/2013	1/0/1900	wetland pool	Spr_Wet1
f1-130620-03	6/20/2013	1/0/1900	wetland pool	Spr_Wet2
f1-130620-04	6/20/2013	1/0/1900	wetland pool	Spr_Wet3
f1-130620-05	6/20/2013	1/0/1900	wetland pool	Spr_Wet4
f1-130620-06	6/20/2013	1/0/1900	snowmelt	Spr_Wr1
f1-130627-01	6/27/2013	1/0/1900	wetland pool	Spr_Wet0
f1-130627-02	6/27/2013	1/0/1900	wetland pool	Spr_Wet1
f1-130627-03	6/27/2013	1/0/1900	wetland pool	Spr_Wet2
f1-130627-04	6/27/2013	1/0/1900	wetland pool	Spr_Wet3
f1-130627-05	6/27/2013	1/0/1900	snowmelt	Spr_Dpnd1
f1-130628-01	6/28/2013	1/0/1900	wetland pool	Spr_Wet5
f1-130705-01	7/5/2013	1/0/1900	snowmelt	Spr_Wr2
f1-130705-02	7/5/2013	1/0/1900	wetland pool	Spr_Wet0
f1-130705-03	7/5/2013	1/0/1900	wetland pool	Spr_Wet1
f1-130705-04	7/5/2013	1/0/1900	wetland pool	Spr_Wet2
f1-130705-05	7/5/2013	1/0/1900	wetland pool	Spr_Wet3
f1-130712-01	7/12/2013	1/0/1900	snowmelt	Tdr_Wr1
f1-130712-02	7/12/2013		snowmelt	Spr_Wr1
f1-130712-03	7/12/2013		wetland pool	Spr_Wet0
f1-130712-04	7/12/2013		wetland pool	Spr_Wet1

2013 V-Swale Evaluation: Samples

SampID	SampDate	SampTime	Matrix	StnID
f1-130712-05	7/12/2013		wetland pool	Spr_Wet2
f1-130712-06	7/12/2013		wetland pool	Spr_Wet3
f1-130719-01	7/19/2013	1/0/1900	snowmelt	Tdr_Wr1

ANALYTICA
Environmental Laboratories

Analytica Group, LLC-Anchorage
4307 Arctic Boulevard
Anchorage, AK 99503
Phone: 907-258-2155
Fax: 907-258-6634

5/28/2013

Municipality of Anchorage - Public Works
PO Box 196650
4700 Elmore
Anchorage, AK 99519
Attn: Kristi Bischofberger

Work Order #: A1305207
Date: 5/28/2013
Work ID: APDES Snow Site Evaluation
Date Received: 5/13/2013
Proj #: none

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
A1305207-01	TDR-WR1	A1305207-02	TDR-WR3
A1305207-03	SPR-WR1		

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Claire K. Toon

Claire Toon
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Group, LLC - Anchorage
Work Order: A1305207

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

SAMPLE RECEIPT:
Three (3) samples were received on 5/13/2013 3:35:00 PM, at a temperature of 15.6°C, at Analytica-Anchorage. The samples were received in good condition and in order per chain of custody.

Comments: The samples were received on ice directly from the sampling site.
The samples were transferred for chloride analysis to Analytica Environmental Laboratories (AEL), 12189 Pennsylvania St., Thornton, Colorado 80241, where they were received at a temperature of 2.4°C, in good condition and in order per chain of custody on 5/16/2013.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below.

All analytical results contained in this report have been reviewed under Analytica's internal quality assurance and quality control program. Any deviations in quality control parameters for specific analyses are noted in the following text. A complete quality assurance report, including laboratory control, matrix spike, and sample duplicate recoveries is kept on file in our office and is available upon request.

All method specifications were met for the following tests, unless otherwise noted:

Test Method: Inorganic Anions by Ion Chromatography - Anions by IC2 - Aqueous

Test Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TSS - Aqueous

Comments: The entire TSS sample volume was filtered for each sample. For samples TDR-WR1 and TDR-WR3, two filters were required.

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305207

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **TDR-WR1**

Matrix: Aqueous

Collection Date: 5/13/2013 1:35:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305207-01A	Analysis Date:	5/17/2013 2:30:00PM
Prep Date:	5/17/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130522008		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	**CASNo**	**Result**	**Flags**	**Units**	**PQL**	**MDL**		**run #:**
Total Suspended Solids		**20.0**		mg/L	0.97		0.49	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1305207-01B	Analysis Date:	5/21/2013 5:44:00PM
Prep Date:	5/20/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	40.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	20
Prep Batch Number:	T130520013		
Report Basis:	As Received	Analyst Initials:	jkk
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	**CASNo**	**Result**	**Flags**	**Units**	**PQL**	**MDL**	**run #:**
Chloride		**816**		mg/L	10	1.4	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305207

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **TDR-WR3**

Matrix: Aqueous

Collection Date: 5/13/2013 1:59:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305207-02A	Analysis Date:	5/17/2013 2:30:00PM
Prep Date:	5/17/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130522008		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**59.4**		mg/L	0.99	0.49	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1305207-02B	Analysis Date:	5/21/2013 6:27:00PM
Prep Date:	5/20/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	43.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	10
Prep Batch Number:	T130520013		
Report Basis:	As Received	Analyst Initials:	jk
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**440**		mg/L	5.0	0.71	2

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305207

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **SPR-WR1**

Matrix: Aqueous

Collection Date: 5/13/2013 2:39:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305207-03A	Analysis Date:	5/17/2013 2:30:00PM
Prep Date:	5/17/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130522008		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**1.78**		mg/L	0.94	0.47	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1305207-03B	Analysis Date:	5/21/2013 4:17:00PM
Prep Date:	5/20/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	34.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	2
Prep Batch Number:	T130520013		
Report Basis:	As Received	Analyst Initials:	jk
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**96.6**		mg/L	1.0	0.14	2

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305207

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **148,961** **Lab Project Number:** **A1305207**

Prep Date: 5/20/2013

Lab Method Blank Id: T130520013-MB

Prep Batch ID: T130520013

Method: Inorganic Anions by Ion Chromatography - Anions by IC2

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T130520013-LCS	LCS	12.0000.XLS	5/21/2013 11:00:00AM
A1305209-01A	Batch QC	14.0000.XLS	5/21/2013 11:29:00AM
A1305209-01A-DUP	DUP	15.0000.XLS	5/21/2013 11:44:00AM
A1305209-01A-MS	MS	16.0000.XLS	5/21/2013 11:58:00AM
A1305209-01A-MSD	MSD	17.0000.XLS	5/21/2013 12:12:00PM
A1305207-03B	SPR-WR1	34.0000.XLS	5/21/2013 4:17:00PM
A1305207-01B	TDR-WR1	40.0000.XLS	5/21/2013 5:44:00PM
A1305207-02B	TDR-WR3	43.0000.XLS	5/21/2013 6:27:00PM

Prep Date: 5/17/2013

Lab Method Blank Id: A130522008-MB

Prep Batch ID: A130522008

Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - T

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
A1305207-01A	TDR-WR1		5/17/2013 2:30:00PM
A1305207-02A	TDR-WR3		5/17/2013 2:30:00PM
A1305207-03A	SPR-WR1		5/17/2013 2:30:00PM
A1305286-05A	Batch QC		5/17/2013 2:30:00PM
A130522008-LCS	LCS		5/17/2013 2:30:00PM
A1305286-05A-DUP	DUP		5/17/2013 2:30:00PM

Workorder (SDG): A1305207

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

- ND = Not Detected at or above the Reporting Limit
- NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

- LOW = Recovery is below Lower Control Limit
- HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
- E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

- B = Analyte was detected in the laboratory method blank
- J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

- J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
- W = Post digestion spike did not meet criteria
- S = Reported value determined by the Method of Standard Additions (MSA)

Several ways of defining the limit of detection and quantitation are prevalent in the laboratory industry and may appear in Analytica reports. These include the following:

- MRL = "minimum reporting level", from the EPA Safe Drinking Water program (SDW)
- PQL = "practical quantitation limit", from SW-846
- EQL = "estimated quantitation limit", from SW-846
- LOQ = "limit of quantitation", from a number of authoritative sources

In Analytica's work, all of these terms have the same meaning, equivalent to the EPA definition of the MRL. This reporting level is supported by a satisfactory calibration data point which is at that level or lower, and also is supported by a method detection limit (MDL) determined by the procedure in 40CFR. The MDL is lower than the MRL and represents an estimate of the level where positive detections have a 99% probability of being real, but where quantitation accuracy is unknown.

The MRL as defined by Analytica is the lowest demonstrated point of known quantitation accuracy.
The MRL should not be confused with the MCL, which is the EPA-defined "maximum contaminant level" allowed for certain regulated targets under specific regulations, such as the National Primary Drinking Water Regulations. Normally, the MRL is set at a level which is much lower than the MCL in order to ensure that levels are well below those limits. Not all target analytes have MCL levels established.

Other Flags may be applied. See Case Narrative for Description

Workorder (SDG): A1305207

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

A1305207

TestPkgName	Basis	# Sig Figs	Reporting Limit
2540D/2540D (Aqueous) - TSS	As Received	3	Report to PQL
300.0/300.0 (Aqueous) - Anions by IC2	As Received	3	Report to PQL

ANALYTICA GROUP

Analytica Chain of Custody Form

12189 Pennsylvania St.
Thornton, CO 80241
(303) 469-8868
(303) 469-5254 fax

4307 Arctic Boulevard
Anchorage, AK 99503
(907) 258-2155
(907) 258-6634 fax

475 Hall St.
Fairbanks, AK 99701
(907) 456-3116
(907) 456 3125 fax

1203 W. Parks HWY
Wasilla, AK 99654
(907) 373-5440

Chain of Custody No: 085916

Client Name & Address: MOA - WMS

Public Water System (PWS) ID#:

Project Name: Snow Site Evaluation

Section to be Completed by Analytica
Quote ID: LGN: A1305207
Account #: Check Credit Card

Report to: Scott B Wheaton
Phone No: 343-8117
Fax No:
E-mail: WheatonSR@muni.org

Turnaround Time for Results (TAT)
___ Standard ___ Expedited (< 10 days, prior authorization required)
___ Routine ___ Non-Routine (please specify due date below; add'tl charges may apply)

Requested Due Date for Results:

Invoice to Name & Address:

Special Instructions/Comments: Samples rec'd on ice, directly from sampling site

P.O. or Contract No:

Kit Prep/Shipping Charge: $

Requested Analysis/Method

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	TSS/SSX Lot #: Pres:	Cl⁻ Lot #: Pres: 300.	Lot #: Pres:	Lot #: Pres:	Lot #: Pres:	Lot #: Pres:	Lot #: Pres:	Field Preserved	Field Filtered	MS/MSD ?
TDR-WB1	5/13/2013	1335	WW		↓	↓								
TDR-WB3	↓	1359	↓		↓	↓								
SPB-WB1	↓	1439	↓		↓	↓								

Relinquished by:	Date	Time	Received by:	Date	Time
[signature]	5/13/13	15:35	[signature]	5/13/13	1535
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Name of Sampler: (printed)

Section to be completed by Analytica

	THO	ANC	FBKS	WAS
Condition of Custody Seal?		N/A		
Initialed by:		—		
Temp/Loc:		15.6		
Thermo ID#:		94969		
Shipped Via:		Client		

Version 2.0

ANALYTICA
Environmental Laboratories

Analytica Group, LLC-Anchorage
4307 Arctic Boulevard
Anchorage, AK 99503
Phone: 907-258-2155
Fax: 907-258-6634

5/31/2013

Municipality of Anchorage - Public Works
PO Box 196650
4700 Elmore
Anchorage, AK 99519
Attn: Kristi Bischofberger

Work Order #: A1305306
Date: 5/31/2013
Work ID: APDES Snow Site Evaluation
Date Received: 5/16/2013
Proj #: none

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
A1305306-01	TDR-WR1	A1305306-02	SPR-WR1
A1305306-03	SPR-WR2		

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Claire K. Toon

Claire Toon
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Group, LLC - Anchorage

Work Order: A1305306

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

SAMPLE RECEIPT:
Three (3) samples were received on 5/16/2013 2:40:00 PM, at a temperature of 10.4°C, at Analytica-Anchorage. The samples were received in good condition and in order per chain of custody.

Comments: The samples were received on ice directly from the sampling site.

The samples were transferred for chloride analysis to Analytica Environmental Laboratories (AEL), 12189 Pennsylvania St., Thornton, Colorado 80241, where they were received at a temperature of 5.6°C, in good condition and in order per chain of custody on 5/21/2013.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below.

All analytical results contained in this report have been reviewed under Analytica's internal quality assurance and quality control program. Any deviations in quality control parameters for specific analyses are noted in the following text. A complete quality assurance report, including laboratory control, matrix spike, and sample duplicate recoveries is kept on file in our office and is available upon request.

All method specifications were met for the following tests, unless otherwise noted:

Test Method: Inorganic Anions by Ion Chromatography - Anions by IC2 - Aqueous

Test Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TSS - Aqueous

Comments: The entire TSS sample volume was filtered for each sample.

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305306

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **TDR-WR1**

Matrix: Aqueous

Collection Date: 5/16/2013 1:17:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305306-01A	Analysis Date:	5/17/2013 2:30:00PM
Prep Date:	5/17/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130522008		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**6.80**		mg/L	1.0	0.50	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1305306-01B	Analysis Date:	5/30/2013 8:22:00PM
Prep Date:	5/29/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	19.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	20
Prep Batch Number:	T130529027		
Report Basis:	As Received	Analyst Initials:	TE
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**689**		mg/L	10	1.4	2

Detailed Analytical Report Analytica Group, LLC - Anchorage

Workorder (SDG): A1305306

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **SPR-WR1**

Matrix: Aqueous Collection Date: 5/16/2013 2:08:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305306-02A	Analysis Date:	5/17/2013 2:30:00PM
Prep Date:	5/17/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130522008		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**1.99**		mg/L	0.95	0.47	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1305306-02B	Analysis Date:	5/29/2013 5:54:00PM
Prep Date:	5/29/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	18.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	2
Prep Batch Number:	T130529027		
Report Basis:	As Received	Analyst Initials:	TE/
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**109**		mg/L	1.0	0.14	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305306

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **SPR-WR2**

Matrix: Aqueous

Collection Date: 5/16/2013 1:58:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305306-03A	Analysis Date:	5/17/2013 2:30:00PM
Prep Date:	5/17/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130522008		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**2.67**		mg/L	0.95	0.48	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1305306-03B	Analysis Date:	5/29/2013 6:08:00PM
Prep Date:	5/29/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	19.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	2
Prep Batch Number:	T130529027		
Report Basis:	As Received	Analyst Initials:	TE/
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**110**		mg/L	1.0	0.14	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305306

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **149,155** **Lab Project Number:** **A1305306**

Prep Date: 5/17/2013

Lab Method Blank Id: A130522008-MB
Prep Batch ID: A130522008
Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - T

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
A1305286-05A	Batch QC		5/17/2013 2:30:00PM
A1305306-01A	TDR-WR1		5/17/2013 2:30:00PM
A1305306-02A	SPR-WR1		5/17/2013 2:30:00PM
A1305306-03A	SPR-WR2		5/17/2013 2:30:00PM
A130522008-LCS	LCS		5/17/2013 2:30:00PM
A1305286-05A-DUP	DUP		5/17/2013 2:30:00PM

Prep Date: 5/29/2013

Lab Method Blank Id: T130529027-MB
Prep Batch ID: T130529027
Method: Inorganic Anions by Ion Chromatography - Anions by IC2

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T130529027-LCS	LCS	12.0000.XLS	5/29/2013 4:27:00PM
A1305377-01E	Batch QC	14.0000.XLS	5/29/2013 4:56:00PM
A1305377-01E-DUP	DUP	15.0000.XLS	5/29/2013 5:11:00PM
A1305377-01E-MS	MS	16.0000.XLS	5/29/2013 5:25:00PM
A1305377-01E-MSD	MSD	17.0000.XLS	5/29/2013 5:39:00PM
A1305306-02B	SPR-WR1	18.0000.XLS	5/29/2013 5:54:00PM
A1305306-01B	TDR-WR1	19.0000.XLS	5/30/2013 8:22:00PM
A1305306-03B	SPR-WR2	19.0000.XLS	5/29/2013 6:08:00PM

Workorder (SDG): A1305306

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

- ND = Not Detected at or above the Reporting Limit
- NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

- LOW = Recovery is below Lower Control Limit
- HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
- E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

- B = Analyte was detected in the laboratory method blank
- J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

- J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
- W = Post digestion spike did not meet criteria
- S = Reported value determined by the Method of Standard Additions (MSA)

Several ways of defining the limit of detection and quantitation are prevalent in the laboratory industry and may appear in Analytica reports. These include the following:

- MRL = "minimum reporting level", from the EPA Safe Drinking Water program (SDW)
- PQL = "practical quantitation limit", from SW-846
- EQL = "estimated quantitation limit", from SW-846
- LOQ = "limit of quantitation", from a number of authoritative sources

In Analytica's work, all of these terms have the same meaning, equivalent to the EPA definition of the MRL. This reporting level is supported by a satisfactory calibration data point which is at that level or lower, and also is supported by a method detection limit (MDL) determined by the procedure in 40CFR. The MDL is lower than the MRL and represents an estimate of the level where positive detections have a 99% probability of being real, but where quantitation accuracy is unknown.

The MRL as defined by Analytica is the lowest demonstrated point of known quantitation accuracy.
The MRL should not be confused with the MCL, which is the EPA-defined "maximum contaminant level" allowed for certain regulated targets under specific regulations, such as the National Primary Drinking Water Regulations. Normally, the MRL is set at a level which is much lower than the MCL in order to ensure that levels are well below those limits. Not all target analytes have MCL levels established.

Other Flags may be applied. See Case Narrative for Description

Workorder (SDG): A1305306

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

A1305306

TestPkgName	Basis	# Sig Figs	Reporting Limit
2540D/2540D (Aqueous) - TSS	As Received	3	Report to PQL
300.0/300.0 (Aqueous) - Anions by IC2	As Received	3	Report to PQL

Analytica Chain of Custody Form

ANALYTICA GROUP

12189 Pennsylvania St.
Thornton, CO 80241
(303) 469-8868
(303) 469-5254 fax

4307 Arctic Boulevard
Anchorage, AK 99503
(907) 258-2155
(907) 258-6634 fax

475 Hall St.
Fairbanks, AK 99701
(907) 456-3116
(907) 456 3125 fax

1203 W. Parks HWY
Wasilla, AK 99654
(907) 373-5440

Chain of Custody No: 085059

Client Name & Address: MOA WMS

Report to: Scott R Wheaton
Phone No: 343-8117
Fax No:
E-mail: WheatonSR@muni.org
Special Instructions/Comments:

Public Water System (PWS) ID#:

Project Name: Sno Site Evaluation

Turnaround Time for Results (TAT)

___ Standard ___ Expedited (< 10 days, prior authorization required)
___ Routine ___ Non-Routine (please specify due date below; add'l charges may apply)

Requested Due Date for Results:

Section to be Completed by Analytica

Quote ID: | LGN: A1305306
Account #: | Check | Credit Card

Invoice to Name & Address:

P.O. or Contract No:

Kit Prep/Shipping Charge: $

Requested Analysis/Method

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	TSS/SSC Lot #: Pres:	Cl⁻ Lot #: Pres: 300.	Lot #: Pres:	Lot #: Pres:	Lot #: Pres:	Lot #: Pres:	Lot #: Pres:	Field Preserved	Field Filtered	MS/MSD ?
TDB-WR1	5/14/2013	1317	WW		✓	✓								
SPR-WR1	↓	1408	↓		↓	↓								
SPR-WR2	↓	1358	↓		↓	↓								

Relinquished by:	Date	Time	Received by:	Date	Time
Scott Wheaton (signature)	5/14/2013	1440	(signature)	5/16/13	1440
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Name of Sampler: (printed)

Section to be completed by Analytica

	THO	ANC	FBKS	WAS
Condition of Custody Seal?		N/A		
Initialed by:		—		
Temp/Loc:		10.4 *		
Thermo ID#:		94969		
Shipped Via:		Client		

* Samples rec'd directly from sampling site.

Version 2.0

Analytica Group, LLC-Anchorage
4307 Arctic Boulevard
Anchorage, AK 99503
Phone: 907-258-2155
Fax: 907-258-6634

ANALYTICA
Environmental Laboratories

6/7/2013

Municipality of Anchorage - Public Works
PO Box 196650
4700 Elmore
Anchorage, AK 99519
Attn: Kristi Bischofberger

Work Order #: A1305394
Date: 6/7/2013
Work ID: APDES Snow Site Evaluation
Date Received: 5/23/2013
Proj #: none

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
A1305394-01	TDR-MPN01	A1305394-02	TDR-WR1
A1305394-03	TDR-DPN01	A1305394-04	SPR-WR2

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Claire K. Toon

Claire Toon
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Group, LLC - Anchorage
Work Order: A1305394

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

SAMPLE RECEIPT:
Four (4) samples were received on 5/23/2013 3:20:00 PM, at a temperature of 16.5°C, at Analytica-Anchorage. The samples were received in good condition and in order per chain of custody.

Comments: The samples were received on ice directly from the sampling site.

The samples were transferred for chloride analysis to Analytica Environmental Laboratories (AEL), 12189 Pennsylvania St., Thornton, Colorado 80241, where they were received at a temperature of 2.6°C, in good condition and in order per chain of custody on 5/29/2013.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below.

All analytical results contained in this report have been reviewed under Analytica's internal quality assurance and quality control program. Any deviations in quality control parameters for specific analyses are noted in the following text. A complete quality assurance report, including laboratory control, matrix spike, and sample duplicate recoveries is kept on file in our office and is available upon request.

All method specifications were met for the following tests, unless otherwise noted:

Test Method: Inorganic Anions by Ion Chromatography - Anions by IC2 - Aqueous

Test Method: SM2510B - Conductivity - Aqueous

Test Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TSS - Aqueous

Comments: The entire TSS sample volume was filtered for each sample.

Test Method: SM4500-H-B Electrometric pH Method - pH - Aqueous

HOLDING TIMES:
pH is a field test requiring immediate analysis. This analysis was performed as soon as possible upon laboratory receipt.

HOLD TIMES MISSED:
Sample SPR-WR2,A1305394-04B

Sampled: 5/23/2013 2:35:00 PM, Prepped: 5/23/2013 3:50:00 PM
Sampled: 5/23/2013 2:35:00 PM, Analyzed: 5/23/2013 3:50:00 PM
Regulatory hold time: 0 Hrs

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305394

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **TDR-MPN01**

Matrix: Aqueous

Collection Date: 5/23/2013 1:40:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number: A1305394-01A

Analysis Date: 5/29/2013 10:45:00AM

Prep Date: 5/29/2013

Instrument: SCALE

Analytical Method ID: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS

File Name:

Prep Method ID: 2540D

Dilution Factor: 0

Prep Batch Number: A130531002

Report Basis: As Received

Analyst Initials: MC

Sample prep wt./vol: 1.00 ml

Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**25.5**		mg/L	1.1	0.53	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: A1305394-01B

Analysis Date: 5/30/2013 9:06:00PM

Prep Date: 5/30/2013

Instrument: IC_2

Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC2

File Name: 22.0000.XLS

Prep Method ID: 300.0

Dilution Factor: 1

Prep Batch Number: T130603017

Report Basis: As Received

Analyst Initials: jkk

Sample prep wt./vol: 4.00 ml

Prep Extract Vol: 4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**30.9**		mg/L	0.50	0.071	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305394

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **TDR-WR1**

Matrix: Aqueous

Collection Date: 5/23/2013 1:56:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305394-02A	Analysis Date:	5/29/2013 10:45:00AM
Prep Date:	5/29/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130531002		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**13.7**		mg/L	0.96	0.48	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1305394-02B	Analysis Date:	6/3/2013 6:24:00PM
Prep Date:	6/3/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	15.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	10
Prep Batch Number:	T130604009		
Report Basis:	As Received	Analyst Initials:	jk
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**235**		mg/L	5.0	0.71	3

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305394

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **TDR-DPN01**

Matrix: Aqueous

Collection Date: 5/23/2013 2:13:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number: A1305394-03A

Analysis Date: 5/29/2013 10:45:00AM

Prep Date: 5/29/2013

Instrument: SCALE

Analytical Method ID: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS

File Name:

Prep Method ID: 2540D

Dilution Factor: 0

Prep Batch Number: A130531002

Report Basis: As Received

Analyst Initials: MC

Sample prep wt./vol: 1.00 ml

Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**8.87**		mg/L	0.97	0.49	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: A1305394-03B

Analysis Date: 5/30/2013 10:18:00PM

Prep Date: 5/30/2013

Instrument: IC_2

Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC2

File Name: 27.0000.XLS

Prep Method ID: 300.0

Dilution Factor: 4

Prep Batch Number: T130603017

Report Basis: As Received

Analyst Initials: jkk

Sample prep wt./vol: 4.00 ml

Prep Extract Vol: 4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**173**		mg/L	2.0	0.28	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305394

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **SPR-WR2**

Matrix: Aqueous

Collection Date: 5/23/2013 2:35:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305394-04B	Analysis Date:	5/23/2013 3:55:00PM
Prep Date:	5/23/2013	Instrument:	Probe
Analytical Method ID:	SM2510B - Conductivity	File Name:	
Prep Method ID:		Dilution Factor:	1
Prep Batch Number:	A130606002		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	50.00 ml	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Conductivity		**350**		umhos/cm	5.0	1.0	1

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305394-04A	Analysis Date:	5/29/2013 10:45:00AM
Prep Date:	5/29/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130531002		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**2.39**		mg/L	0.96	0.48	1

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305394-04B	Analysis Date:	5/23/2013 3:50:00PM
Prep Date:	5/23/2013	Instrument:	Probe
Analytical Method ID:	SM4500-H-B Electrometric pH Method - pH	File Name:	
Prep Method ID:	4500-H-B	Dilution Factor:	1
Prep Batch Number:	A130605002		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**8.5**		pH	0.0	0.0	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1305394-04B	Analysis Date:	5/30/2013 10:32:00PM
Prep Date:	5/30/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	28.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	4
Prep Batch Number:	T130603017		
Report Basis:	As Received	Analyst Initials:	jkk
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**89.1**		mg/L	2.0	0.28	1

Detailed Analytical Report Analytica Group, LLC - Anchorage

Workorder (SDG): A1305394

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **SPR-WR2**

Matrix: Aqueous Collection Date: 5/23/2013 2:35:00PM

Workorder (SDG): A1305394

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **149,342** **Lab Project Number:** **A1305394**

Prep Date: 5/29/2013

Lab Method Blank Id: A130531002-MB
Prep Batch ID: A130531002
Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - T

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
A1305394-01A	TDR-MPN01		5/29/2013 10:45:00AM
A1305394-02A	TDR-WR1		5/29/2013 10:45:00AM
A1305394-03A	TDR-DPN01		5/29/2013 10:45:00AM
A1305394-04A	SPR-WR2		5/29/2013 10:45:00AM
A1305400-04A	Batch QC		5/29/2013 10:45:00AM
A130531002-LCS	LCS		5/29/2013 10:45:00AM
A1305400-04A-DUP	DUP		5/29/2013 10:45:00AM

Prep Date: 5/30/2013

Lab Method Blank Id: T130603017-MB
Prep Batch ID: T130603017
Method: Inorganic Anions by Ion Chromatography - Anions by IC2

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T130603017-LCS	LCS	12.0000.XLS	5/30/2013 6:42:00PM
B1305164-01B	Batch QC	14.0000.XLS	5/30/2013 7:10:00PM
B1305164-01B-DUP	DUP	15.0000.XLS	5/30/2013 7:25:00PM
B1305164-01B-MS	MS	16.0000.XLS	5/30/2013 7:39:00PM
B1305164-01B-MSD	MSD	17.0000.XLS	5/30/2013 7:54:00PM
A1305394-01B	TDR-MPN01	22.0000.XLS	5/30/2013 9:06:00PM
A1305394-03B	TDR-DPN01	27.0000.XLS	5/30/2013 10:18:00PM
A1305394-04B	SPR-WR2	28.0000.XLS	5/30/2013 10:32:00PM

Prep Date: 6/3/2013

Lab Method Blank Id: T130604009-MB
Prep Batch ID: T130604009
Method: Inorganic Anions by Ion Chromatography - Anions by IC2

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T130604009-LCS	LCS	12.0000.XLS	6/3/2013 5:41:00PM
A1305394-02B	TDR-WR1	15.0000.XLS	6/3/2013 6:24:00PM

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305394

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **149,342** **Lab Project Number:** **A1305394**

Prep Date: 5/23/2013

Lab Method Blank Id: A130606002-MB

Prep Batch ID: A130606002

Method: SM2510B - Conductivity

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
A1305394-04B	SPR-WR2		5/23/2013 3:55:00PM
A130606002-LCS	LCS		5/23/2013 3:55:00PM

Workorder (SDG): A1305394

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

- ND = Not Detected at or above the Reporting Limit
- NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

- LOW = Recovery is below Lower Control Limit
- HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
- E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

- B = Analyte was detected in the laboratory method blank
- J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

- J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
- W = Post digestion spike did not meet criteria
- S = Reported value determined by the Method of Standard Additions (MSA)

Several ways of defining the limit of detection and quantitation are prevalent in the laboratory industry and may appear in Analytica reports. These include the following:

- MRL = "minimum reporting level", from the EPA Safe Drinking Water program (SDW)
- PQL = "practical quantitation limit", from SW-846
- EQL = "estimated quantitation limit", from SW-846
- LOQ = "limit of quantitation", from a number of authoritative sources

In Analytica's work, all of these terms have the same meaning, equivalent to the EPA definition of the MRL. This reporting level is supported by a satisfactory calibration data point which is at that level or lower, and also is supported by a method detection limit (MDL) determined by the procedure in 40CFR. The MDL is lower than the MRL and represents an estimate of the level where positive detections have a 99% probability of being real, but where quantitation accuracy is unknown.

The MRL as defined by Analytica is the lowest demonstrated point of known quantitation accuracy.
The MRL should not be confused with the MCL, which is the EPA-defined "maximum contaminant level" allowed for certain regulated targets under specific regulations, such as the National Primary Drinking Water Regulations. Normally, the MRL is set at a level which is much lower than the MCL in order to ensure that levels are well below those limits. Not all target analytes have MCL levels established.

Other Flags may be applied. See Case Narrative for Description

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305394

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

A1305394

TestPkgName	Basis	# Sig Figs	Reporting Limit
2510B (Aqueous) - Conductivity	As Received	3	Report to PQL
2540D/2540D (Aqueous) - TSS	As Received	3	Report to PQL
300.0/300.0 (Aqueous) - Anions by IC2	As Received	3	Report to PQL
4500-H-B/4500-H-B (Aqueous) - pH	As Received	2	Report to PQL

Analytica Chain of Custody Form

ANALYTICA GROUP

12189 Pennsylvania St.
Thornton, CO 80241
(303) 469-8868
(303) 469-5254 fax

4307 Arctic Boulevard
Anchorage, AK 99503
(907) 258-2155
(907) 258-6634 fax

475 Hall St.
Fairbanks, AK 99701
(907) 456-3116
(907) 456 3125 fax

1203 W. Parks HWY
Wasilla, AK 99654
(907) 373-5440

Page ____ of ____

Chain of Custody No: 085060

Client Name & Address: MOA WMS

Report to: Scott R Wheaton

Phone No: 343-8117

Fax No:

E-mail: WheatonSR@muni.org

Special Instructions/Comments:

Public Water System (PWS) ID#:

Project Name: Snow Site Evaluation

Turnaround Time for Results (TAT)

___ Standard ___ Expedited (< 10 days, prior authorization required)
___ Routine ___ Non-Routine (please specify due date below: add'l charges may apply)

Requested Due Date for Results:

Section to be Completed by Analytica

Quote ID:
LGN: A1305394
Account #: Check Credit Card

Invoice to Name & Address:

P.O. or Contract No:

Kit Prep/Shipping Charge: $

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	TSS/SSC	Cl⁻	pH	Conductivity				Field Preserved	Field Filtered	MS/MSD ?
TDR-MPND1	5/20/2013	1340	SW		✓	✓								
TDR-WR1	↓	1356	↓		↓	↓								
TDR-DPND1	↓	1413	↓		↓	↓								
SPR-WR2	↓	1435	↓		↓	↓	✓	✓						

(Requested Analysis/Method columns each have Lot #: / Pres: fields.)

Relinquished by:	Date	Time	Received by:	Date	Time
Scott R Wheaton	5/23/2013	15:20	[signature]	5/23/13	1520

Name of Sampler: (printed)

Section to be completed by Analytica

	THO	ANC	FBKS	WAS
Condition of Custody Seal?		NA		
Initialed by:		–		
Temp/Loc:		16-5		
Thermo ID#:		94969		
Shipped Via:		Client		

Version 2.0

* ~~Client~~ samples received directly from sampling site.

ANALYTICA
Environmental Laboratories

Analytica Group, LLC-Anchorage
4307 Arctic Boulevard
Anchorage, AK 99503
Phone: 907-258-2155
Fax: 907-258-6634

6/14/2013

Municipality of Anchorage - Public Works
PO Box 196650
4700 Elmore
Anchorage, AK 99519
Attn: Kristi Bischofberger

Work Order #: A1305486
Date: 6/14/2013
Work ID: APDES Snow Site Evaluation
Date Received: 5/30/2013
Proj #: none

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
A1305486-01	TDR-STRM	A1305486-02	TDR-WR1
A1305486-03	SPR-WR1	A1305486-04	SPR-WR2

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Claire K. Toon

Claire Toon
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Group, LLC - Anchorage

Work Order: A1305486

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

SAMPLE RECEIPT:
Four (4) samples were received on 5/30/2013 1:53:00 PM, at a temperature of 11.7°C, at Analytica-Anchorage. The samples were received in good condition and in order per chain of custody.

Comments: The samples were received on ice directly from the sampling site.
The samples were transferred for chloride analysis to Analytica Environmental Laboratories (AEL), 12189 Pennsylvania St., Thornton, Colorado 80241, where they were received at a temperature of 5.2°C, in good condition and in order per chain of custody on 6/4/2013.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below.

All analytical results contained in this report have been reviewed under Analytica's internal quality assurance and quality control program. Any deviations in quality control parameters for specific analyses are noted in the following text. A complete quality assurance report, including laboratory control, matrix spike, and sample duplicate recoveries is kept on file in our office and is available upon request.

All method specifications were met for the following tests, unless otherwise noted:

Test Method: Inorganic Anions by Ion Chromatography - Anions by IC2 - Aqueous

Test Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TSS - Aqueous

Comments: The entire TSS sample volume was filtered for each sample.

Test Method: SM4500-H-B Electrometric pH Method - pH - Aqueous

HOLDING TIMES:
pH is a field test requiring immediate analysis. This analysis was performed as soon as possible upon laboratory receipt.

HOLD TIMES MISSED:
Sample SPR-WR1,A1305486-03B
Sampled: 5/30/2013 1:08:00 PM, Prepped: 5/30/2013 4:00:00 PM
Sampled: 5/30/2013 1:08:00 PM, Analyzed: 5/30/2013 4:00:00 PM
Regulatory hold time: 0 Hrs

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305486

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **TDR-STRM**

Matrix: Aqueous

Collection Date: 5/30/2013 12:09:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305486-01A	Analysis Date:	5/31/2013 3:45:00PM
Prep Date:	5/31/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130604005		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**2.54**		mg/L	0.98	0.49	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1305486-01B	Analysis Date:	6/13/2013 4:39:00PM
Prep Date:	6/12/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	15.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	4
Prep Batch Number:	T130612024		
Report Basis:	As Received	Analyst Initials:	TE
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**138**		mg/L	2.0	0.28	2

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305486

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **TDR-WR1**

Matrix: Aqueous

Collection Date: 5/30/2013 12:31:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number: A1305486-02A
Analysis Date: 5/31/2013 3:45:00PM
Prep Date: 5/31/2013
Instrument: SCALE
Analytical Method ID: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS
File Name:
Prep Method ID: 2540D
Dilution Factor: 0
Prep Batch Number: A130604005
Report Basis: As Received
Analyst Initials: MC
Sample prep wt./vol: 1.00 ml
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**43.0**		mg/L	0.96	0.48	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: A1305486-02B
Analysis Date: 6/12/2013 8:15:00PM
Prep Date: 6/12/2013
Instrument: IC_2
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC2
File Name: 27.0000.XLS
Prep Method ID: 300.0
Dilution Factor: 1
Prep Batch Number: T130612024
Report Basis: As Received
Analyst Initials: TE
Sample prep wt./vol: 4.00 ml
Prep Extract Vol: 4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**40.2**		mg/L	0.50	0.071	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305486

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **SPR-WR1**

Matrix: Aqueous   Collection Date: 5/30/2013 1:08:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305486-03A	Analysis Date:	5/31/2013 3:45:00PM
Prep Date:	5/31/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130604005		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**6.89**		mg/L	0.94	0.47	1

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305486-03B	Analysis Date:	5/30/2013 4:00:00PM
Prep Date:	5/30/2013	Instrument:	Probe
Analytical Method ID:	SM4500-H-B Electrometric pH Method - pH	File Name:	
Prep Method ID:	4500-H-B	Dilution Factor:	1
Prep Batch Number:	A130606005		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**9.5**		pH	0.0	0.0	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1305486-03B	Analysis Date:	6/12/2013 8:30:00PM
Prep Date:	6/12/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	28.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	1
Prep Batch Number:	T130612024		
Report Basis:	As Received	Analyst Initials:	TE
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**42.0**		mg/L	0.50	0.071	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305486

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **SPR-WR2**

Matrix: Aqueous | Collection Date: 5/30/2013 1:16:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1305486-04A	Analysis Date:	5/31/2013 3:45:00PM
Prep Date:	5/31/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130604005		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**6.32**		mg/L	0.97	0.49	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1305486-04B	Analysis Date:	6/12/2013 8:44:00PM
Prep Date:	6/12/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	29.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	1
Prep Batch Number:	T130612024		
Report Basis:	As Received	Analyst Initials:	TE
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**41.5**		mg/L	0.50	0.071	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1305486

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **149,541** **Lab Project Number:** **A1305486**

Prep Date: 5/31/2013

Lab Method Blank Id: A130604005-MB

Prep Batch ID: A130604005

Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - T

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
A1305481-01A	Batch QC		5/31/2013 3:45:00PM
A1305486-01A	TDR-STRM		5/31/2013 3:45:00PM
A1305486-02A	TDR-WR1		5/31/2013 3:45:00PM
A1305486-03A	SPR-WR1		5/31/2013 3:45:00PM
A1305486-04A	SPR-WR2		5/31/2013 3:45:00PM
A130604005-LCS	LCS		5/31/2013 3:45:00PM
A1305481-01A-DUP	DUP		5/31/2013 3:45:00PM

Prep Date: 6/12/2013

Lab Method Blank Id: T130612024-MB

Prep Batch ID: T130612024

Method: Inorganic Anions by Ion Chromatography - Anions by IC2

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T130612024-LCS	LCS	12.0000.XLS	6/12/2013 4:39:00PM
A1305486-01B	TDR-STRM	15.0000.XLS	6/13/2013 4:39:00PM
B1306047-02A	Batch QC	15.0000.XLS	6/12/2013 5:22:00PM
B1306047-02A-DUP	DUP	16.0000.XLS	6/12/2013 5:37:00PM
B1306047-02A-MS	MS	17.0000.XLS	6/12/2013 5:51:00PM
B1306047-02A-MSD	MSD	18.0000.XLS	6/12/2013 6:06:00PM
A1305486-02B	TDR-WR1	27.0000.XLS	6/12/2013 8:15:00PM
A1305486-03B	SPR-WR1	28.0000.XLS	6/12/2013 8:30:00PM
A1305486-04B	SPR-WR2	29.0000.XLS	6/12/2013 8:44:00PM

Workorder (SDG): A1305486

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

- ND = Not Detected at or above the Reporting Limit
- NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

- LOW = Recovery is below Lower Control Limit
- HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
- E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

- B = Analyte was detected in the laboratory method blank
- J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

- J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
- W = Post digestion spike did not meet criteria
- S = Reported value determined by the Method of Standard Additions (MSA)

Several ways of defining the limit of detection and quantitation are prevalent in the laboratory industry and may appear in Analytica reports. These include the following:

- MRL = "minimum reporting level", from the EPA Safe Drinking Water program (SDW)
- PQL = "practical quantitation limit", from SW-846
- EQL = "estimated quantitation limit", from SW-846
- LOQ = "limit of quantitation", from a number of authoritative sources

In Analytica's work, all of these terms have the same meaning, equivalent to the EPA definition of the MRL. This reporting level is supported by a satisfactory calibration data point which is at that level or lower, and also is supported by a method detection limit (MDL) determined by the procedure in 40CFR. The MDL is lower than the MRL and represents an estimate of the level where positive detections have a 99% probability of being real, but where quantitation accuracy is unknown.

The MRL as defined by Analytica is the lowest demonstrated point of known quantitation accuracy.
The MRL should not be confused with the MCL, which is the EPA-defined "maximum contaminant level" allowed for certain regulated targets under specific regulations, such as the National Primary Drinking Water Regulations. Normally, the MRL is set at a level which is much lower than the MCL in order to ensure that levels are well below those limits. Not all target analytes have MCL levels established.

Other Flags may be applied. See Case Narrative for Description

Workorder (SDG): A1305486

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

A1305486

TestPkgName	Basis	# Sig Figs	Reporting Limit
2540D/2540D (Aqueous) - TSS	As Received	3	Report to PQL
300.0/300.0 (Aqueous) - Anions by IC2	As Received	3	Report to PQL
4500-H-B/4500-H-B (Aqueous) - pH	As Received	2	Report to PQL

Analytica Chain of Custody Form

ANALYTICA GROUP

12189 Pennsylvania St.
Thornton, CO 80241
(303) 469-8868
(303) 469-5254 fax

4307 Arctic Boulevard
Anchorage, AK 99503
(907) 258-2155
(907) 258-6634 fax

475 Hall St.
Fairbanks, AK 99701
(907) 456-3116
(907) 456 3125 fax

1203 W. Parks HWY
Wasilla, AK 99654
(907) 373-5440

Chain of Custody No: 085004

Client Name & Address: MOA - WMS

Report to: Scott R Wheaton

Phone No: 343-8117

Fax No:

E-mail: WheatonSR@muni.org

Special Instructions/Comments:

Public Water System (PWS) ID#:

Project Name: Snow Site Evaluation

Turnaround Time for Results (TAT)

___ **Standard** ___ **Expedited** (< 10 days, prior authorization required)

___ **Routine** ___ **Non-Routine** (please specify due date below; add'l charges may apply)

Requested Due Date for Results:

Section to be Completed by Analytica

Quote ID: LGN: A1305486

Account #: Check Credit Card

Invoice to Name & Address:

P.O. or Contract No:

Kit Prep/Shipping Charge: $

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	TSS/SSC (Lot #: Pres:)	Cl⁻ (Lot #: Pres:)	pH (Lot #: Pres:)	Lot #: Pres:	Lot #: Pres:	Lot #: Pres:	Lot #: Pres:	Field Preserved	Field Filtered	MS/MSD ?
TDR-STRM	5/30/2013	1209			✓	✓								
TDR-WR1	↓	1231			↓	↓								
SPR-WR1	↓	1308			↓	↓	X							
SPR-WR2	↓	1316			↓	↓								

Relinquished by:	Date	Time	Received by:	Date	Time
[signature]	5/30/2013		[signature]	5/30/13	1353
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Name of Sampler: (printed)

Section to be completed by Analytica

	THO	ANC	FBKS	WAS
Condition of Custody Seal?		N/A		
Initialed by:		–		
Temp/Loc:		11-7*		
Thermo ID#:		94969		
Shipped Via:		Client		

Version 2.0

rec'd directly from sampling site, on ice.

Analytica Group, LLC-Anchorage
4307 Arctic Boulevard
Anchorage, AK 99503
Phone: 907-258-2155
Fax: 907-258-6634

ANALYTICA
Environmental Laboratories

6/21/2013

Municipality of Anchorage - Public Works
PO Box 196650
4700 Elmore
Anchorage, AK 99519
Attn: Kristi Bischofberger

Work Order #: A1306138
Date: 6/21/2013
Work ID: APDES Snow Site Evaluation
Date Received: 6/6/2013
Proj #: none

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
A1306138-01	TDR-WR1	A1306138-02	SPR-WR2

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Claire K. Toon

Claire Toon
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Group, LLC - Anchorage

Work Order: A1306138

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

SAMPLE RECEIPT:
Two (2) samples were received on 6/6/2013 2:25:00 PM, at a temperature of 18.6°C, at Analytica-Anchorage. The samples were received in good condition and in order per chain of custody.

Comments: The samples were received on ice directly from the sampling site.

The samples were transferred for chloride analysis to Analytica Environmental Laboratories (AEL), 12189 Pennsylvania St., Thornton, Colorado 80241, where they were received at a temperature of 5.6°C, in good condition and in order per chain of custody on 6/11/2013.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below.

All analytical results contained in this report have been reviewed under Analytica's internal quality assurance and quality control program. Any deviations in quality control parameters for specific analyses are noted in the following text. A complete quality assurance report, including laboratory control, matrix spike, and sample duplicate recoveries is kept on file in our office and is available upon request.

All method specifications were met for the following tests, unless otherwise noted:

Test Method: Inorganic Anions by Ion Chromatography - Anions by IC2 - Surface Water

Test Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TSS - Surface Water

Comments: The entire TSS sample volume was filtered for each sample.

Workorder (SDG): A1306138

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **TDR-WR1**

Matrix: Surface Water Collection Date: 6/6/2013 12:57:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1306138-01A	Analysis Date:	6/8/2013 4:16:00PM
Prep Date:	6/8/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130611016		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**109**		mg/L	1.00	0.50	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1306138-01B	Analysis Date:	6/12/2013 8:58:00PM
Prep Date:	6/12/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	30.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	1
Prep Batch Number:	T130612024		
Report Basis:	As Received	Analyst Initials:	TE
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**17.5**		mg/L	0.50	0.071	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1306138

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **SPR-WR2**

Matrix: Surface Water

Collection Date: 6/6/2013 1:27:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1306138-02A	Analysis Date:	6/8/2013 4:16:00PM
Prep Date:	6/8/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130611016		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**4.38**		mg/L	0.95	0.48	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1306138-02B	Analysis Date:	6/12/2013 9:13:00PM
Prep Date:	6/12/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	31.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	1
Prep Batch Number:	T130612024		
Report Basis:	As Received	Analyst Initials:	TE
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**23.1**		mg/L	0.50	0.071	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1306138

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **149,851** **Lab Project Number:** **A1306138**

Prep Date: 6/8/2013

Lab Method Blank Id: A130611016-MB

Prep Batch ID: A130611016

Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - T

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
A1306116-05A	Batch QC		6/8/2013 4:16:00PM
A1306138-01A	TDR-WR1		6/8/2013 4:16:00PM
A1306138-02A	SPR-WR2		6/8/2013 4:16:00PM
A130611016-LCS	LCS		6/8/2013 4:16:00PM
A1306116-05A-DUP	DUP		6/8/2013 4:16:00PM

Prep Date: 6/12/2013

Lab Method Blank Id: T130612024-MB

Prep Batch ID: T130612024

Method: Inorganic Anions by Ion Chromatography - Anions by IC2

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T130612024-LCS	LCS	12.0000.XLS	6/12/2013 4:39:00PM
B1306047-02A	Batch QC	15.0000.XLS	6/12/2013 5:22:00PM
B1306047-02A-DUP	DUP	16.0000.XLS	6/12/2013 5:37:00PM
B1306047-02A-MS	MS	17.0000.XLS	6/12/2013 5:51:00PM
B1306047-02A-MSD	MSD	18.0000.XLS	6/12/2013 6:06:00PM
A1306138-01B	TDR-WR1	30.0000.XLS	6/12/2013 8:58:00PM
A1306138-02B	SPR-WR2	31.0000.XLS	6/12/2013 9:13:00PM

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

- ND = Not Detected at or above the Reporting Limit
- NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

- LOW = Recovery is below Lower Control Limit
- HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
- E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

- B = Analyte was detected in the laboratory method blank
- J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

- J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
- W = Post digestion spike did not meet criteria
- S = Reported value determined by the Method of Standard Additions (MSA)

Several ways of defining the limit of detection and quantitation are prevalent in the laboratory industry and may appear in Analytica reports. These include the following:

- MRL = "minimum reporting level", from the EPA Safe Drinking Water program (SDW)
- PQL = "practical quantitation limit", from SW-846
- EQL = "estimated quantitation limit", from SW-846
- LOQ = "limit of quantitation", from a number of authoritative sources

In Analytica's work, all of these terms have the same meaning, equivalent to the EPA definition of the MRL. This reporting level is supported by a satisfactory calibration data point which is at that level or lower, and also is supported by a method detection limit (MDL) determined by the procedure in 40CFR. The MDL is lower than the MRL and represents an estimate of the level where positive detections have a 99% probability of being real, but where quantitation accuracy is unknown.

The MRL as defined by Analytica is the lowest demonstrated point of known quantitation accuracy.
The MRL should not be confused with the MCL, which is the EPA-defined "maximum contaminant level" allowed for certain regulated targets under specific regulations, such as the National Primary Drinking Water Regulations. Normally, the MRL is set at a level which is much lower than the MCL in order to ensure that levels are well below those limits. Not all target analytes have MCL levels established.

Other Flags may be applied. See Case Narrative for Description

Workorder (SDG): A1306138

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

A1306138

TestPkgName	Basis	# Sig Figs	Reporting Limit
2540D/2540D (Aqueous) - TSS	As Received	3	Report to PQL
300.0/300.0 (Aqueous) - Anions by IC2	As Received	3	Report to PQL

Analytica Chain of Custody Form

ANALYTICA GROUP

12189 Pennsylvania St.
Thornton, CO 80241
(303) 469-8868
(303) 469-5254 fax

4307 Arctic Boulevard
Anchorage, AK 99503
(907) 258-2155
(907) 258-6634 fax

475 Hall St.
Fairbanks, AK 99701
(907) 456-3116
(907) 456 3125 fax

1203 W. Parks HWY
Wasilla, AK 99654
(907) 373-5440

Chain of Custody No: 085005

Client Name & Address: MOA - WMS

Report to: Scott R Wheaton

Phone No: 343-8117

Fax No:

E-mail: WheatonSR@muni.org

Special Instructions/Comments:

Public Water System (PWS) ID#:

Project Name: Snow Site Evaluation

Turnaround Time for Results (TAT)

___ Standard ___ Expedited (< 10 days, prior authorization required)

___ Routine ___ Non-Routine (please specify due date below; add'l charges may apply)

Requested Due Date for Results:

Section to be Completed by Analytica

Quote ID: | LGN: A1306I838

Account #: | Check | Credit Card

Invoice to Name & Address:

P.O. or Contract No:

Kit Prep/Shipping Charge: $

Requested Analysis/Method

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	TSS/SSC (Lot #: Pres:)	Cl⁻ (Lot #: Pres:)	Lot #: Pres:	Lot #: Pres:	Lot #: Pres:	Lot #: Pres:	Lot #: Pres:	Field Preserved	Field Filtered	MS/MSD ?
TDR - WR1	6/6/2013	1257	SW	2	✓	✓								
SPR - WR2	6/6/2013	1327	SW	2	✓	✓								

Relinquished by:	Date	Time	Received by:	Date	Time
[signature]	6/6/2013	1425	[signature]	6/6/13	1425
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Name of Sampler: (printed)

Section to be completed by Analytica

	THO	ANC	FBKS	WAS
Condition of Custody Seal?		N/A		
Initialed by:		—		
Temp/Loc:		18.6*		
Thermo ID#:		94969		
Shipped Via:		Client		

*Samples rec'd on ice directly from sampling site.

Version 2.0

ANALYTICA
Environmental Laboratories

Analytica Group, LLC-Anchorage
4307 Arctic Boulevard
Anchorage, AK 99503
Phone: 907-258-2155
Fax: 907-258-6634

7/8/2013

Municipality of Anchorage - Public Works
PO Box 196650
4700 Elmore
Anchorage, AK 99519
Attn: Kristi Bischofberger

Work Order #: A1306354
Date: 7/8/2013
Work ID: APDES Snow Site Evaluation
Date Received: 6/20/2013
Proj #: none

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
A1306354-01	TDR-WR1	A1306354-02	SPR-WR2

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Claire Toon
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Group, LLC - Anchorage
Work Order: A1306354

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

SAMPLE RECEIPT:
Two (2) samples were received on 6/20/2013 1:50:00 PM, at a temperature of 12.2°C, at Analytica-Anchorage. The samples were received in good condition and in order per chain of custody.

Comments: The samples were received on ice directly from the sampling site.
The samples were transferred for chloride analysis to Analytica Environmental Laboratories (AEL), 12189 Pennsylvania St., Thornton, Colorado 80241, where they were received at a temperature of 4.4°C, in good condition and in order per chain of custody on 6/25/2013.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below.

All analytical results contained in this report have been reviewed under Analytica's internal quality assurance and quality control program. Any deviations in quality control parameters for specific analyses are noted in the following text. A complete quality assurance report, including laboratory control, matrix spike, and sample duplicate recoveries is kept on file in our office and is available upon request.

All method specifications were met for the following tests, unless otherwise noted:

Test Method: Inorganic Anions by Ion Chromatography - Anions by IC2 - Surface Water

Test Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TSS - Surface Water

Test Method: SM4500-H-B Electrometric pH Method - pH - Surface Water

HOLDING TIMES:
pH is a field test requiring immediate analysis. This analysis was performed as soon as possible upon laboratory receipt.

HOLD TIMES MISSED:
Sample SPR-WR2,A1306354-02B
Sampled: 6/20/2013 12:27:00 PM, Prepped: 6/20/2013 3:30:00 PM
Sampled: 6/20/2013 12:27:00 PM, Analyzed: 6/20/2013 3:30:00 PM
Regulatory hold time: 0 Hrs

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1306354

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **TDR-WR1**

Matrix: Surface Water

Collection Date: 6/20/2013 11:55:00AM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1306354-01A	Analysis Date:	6/24/2013 10:45:00AM
Prep Date:	6/24/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130703003		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**240**		mg/L	1.0	0.51	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1306354-01B	Analysis Date:	7/3/2013 7:53:00PM
Prep Date:	7/3/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	21.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	1
Prep Batch Number:	T130705003		
Report Basis:	As Received	Analyst Initials:	TE
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**32.4**		mg/L	0.50	0.071	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1306354

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **SPR-WR2**

Matrix: Surface Water

Collection Date: 6/20/2013 12:27:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1306354-02A	Analysis Date:	6/24/2013 10:45:00AM
Prep Date:	6/24/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130703003		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**11.5**		mg/L	0.96	0.48	1

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1306354-02B	Analysis Date:	6/20/2013 3:30:00PM
Prep Date:	6/20/2013	Instrument:	Probe
Analytical Method ID:	SM4500-H-B Electrometric pH Method - pH	File Name:	
Prep Method ID:	4500-H-B	Dilution Factor:	1
Prep Batch Number:	A130627009		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**7.0**		pH	0.0	0.0	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1306354-02B	Analysis Date:	7/3/2013 8:07:00PM
Prep Date:	7/3/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	22.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	1
Prep Batch Number:	T130705003		
Report Basis:	As Received	Analyst Initials:	TE
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**9.10**		mg/L	0.50	0.071	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1306354

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **150,314** **Lab Project Number:** **A1306354**

Prep Date: 6/24/2013

Lab Method Blank Id: A130703003-MB
Prep Batch ID: A130703003
Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - T

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
A1306344-01A	Batch QC		6/24/2013 10:45:00AM
A1306354-01A	TDR-WR1		6/24/2013 10:45:00AM
A1306354-02A	SPR-WR2		6/24/2013 10:45:00AM
A130703003-LCS	LCS		6/24/2013 10:45:00AM
A1306344-01A-DUP	DUP		6/24/2013 10:45:00AM

Prep Date: 7/3/2013

Lab Method Blank Id: T130705003-MB
Prep Batch ID: T130705003
Method: Inorganic Anions by Ion Chromatography - Anions by IC2

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T130705003-LCS	LCS	12.0000.XLS	7/3/2013 5:43:00PM
A1306381-01G	Batch QC	15.0000.XLS	7/3/2013 6:26:00PM
A1306381-01G-DUP	DUP	16.0000.XLS	7/3/2013 6:41:00PM
A1306381-01G-MS	MS	17.0000.XLS	7/3/2013 6:55:00PM
A1306381-01G-MSD	MSD	18.0000.XLS	7/3/2013 7:10:00PM
A1306354-01B	TDR-WR1	21.0000.XLS	7/3/2013 7:53:00PM
A1306354-02B	SPR-WR2	22.0000.XLS	7/3/2013 8:07:00PM

Workorder (SDG): A1306354

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

ND = Not Detected at or above the Reporting Limit
NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

LOW = Recovery is below Lower Control Limit
HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

B = Analyte was detected in the laboratory method blank
J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
W = Post digestion spike did not meet criteria
S = Reported value determined by the Method of Standard Additions (MSA)

Several ways of defining the limit of detection and quantitation are prevalent in the laboratory industry and may appear in Analytica reports. These include the following:

MRL = "minimum reporting level", from the EPA Safe Drinking Water program (SDW)
PQL = "practical quantitation limit", from SW-846
EQL = "estimated quantitation limit", from SW-846
LOQ = "limit of quantitation", from a number of authoritative sources

In Analytica's work, all of these terms have the same meaning, equivalent to the EPA definition of the MRL. This reporting level is supported by a satisfactory calibration data point which is at that level or lower, and also is supported by a method detection limit (MDL) determined by the procedure in 40CFR. The MDL is lower than the MRL and represents an estimate of the level where positive detections have a 99% probability of being real, but where quantitation accuracy is unknown.

The MRL as defined by Analytica is the lowest demonstrated point of known quantitation accuracy.
The MRL should not be confused with the MCL, which is the EPA-defined "maximum contaminant level" allowed for certain regulated targets under specific regulations, such as the National Primary Drinking Water Regulations. Normally, the MRL is set at a level which is much lower than the MCL in order to ensure that levels are well below those limits. Not all target analytes have MCL levels established.

Other Flags may be applied. See Case Narrative for Description

Workorder (SDG): A1306354

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

A1306354

TestPkgName	Basis	# Sig Figs	Reporting Limit
2540D/2540D (Aqueous) - TSS	As Received	3	Report to PQL
300.0/300.0 (Aqueous) - Anions by IC2	As Received	3	Report to PQL
4500-H-B/4500-H-B (Aqueous) - pH	As Received	2	Report to PQL

ANALYTICA GROUP

Analytica Chain of Custody Form

Page 1 of 1

12189 Pennsylvania St.
Thornton, CO 80241
(303) 469-8868
(303) 469-5254 fax

4307 Arctic Boulevard
Anchorage, AK 99503
(907) 258-2155
(907) 258-6634 fax

475 Hall St.
Fairbanks, AK 99701
(907) 456-3116
(907) 456 3125 fax

1203 W. Parks HWY
Wasilla, AK 99654
(907) 373-5440

Chain of Custody No: 086079

Client Name & Address: MOA - WMS

Report to: Scott R Wheaton

Phone No: 343-8117

Fax No:

E-mail: WheatonSR@muni.org

Special Instructions/Comments:

Public Water System (PWS) ID#:

Project Name: Snow Site Evaluation

Turnaround Time for Results (TAT)

___ Standard ___ Expedited (< 10 days, prior authorization required)
___ Routine ___ Non-Routine (please specify due date below: add'l charges may apply)

Requested Due Date for Results:

Section to be Completed by Analytica

Quote ID: LGN: A1306354

Account #: Check Credit Card

Invoice to Name & Address:

P.O. or Contract No:

Kit Prep/Shipping Charge: $

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	TSS/SSC (Lot #: Pres:)	Cl⁻ (Lot #: Pres:)	PH (Lot #: Pres:)	Lot #: Pres:	Lot #: Pres:	Lot #: Pres:	Lot #: Pres:	Field Preserved	Field Filtered	MS/MSD ?
TDR-WR1	6/20/2013	1155	SW	2	2	2								
SPR-WR2	↓	1227	↓	2	↓	↓	X							

Relinquished by:	Date	Time	Received by:	Date	Time
[signature]	6/20/2013	1350	[signature]	6/20/13	1350
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Name of Sampler: (printed)

Section to be completed by Analytica

	THO	ANC	FBKS	WAS
Condition of Custody Seal?		N/A		
Initialed by:		—		
Temp/Loc:		12.2*		
Thermo ID#:		94969		
Shipped Via:		Client		

*samples rec'd directly from sampling site.

Version 2.0

ANALYTICA
Environmental Laboratories

Analytica Group, LLC-Anchorage
4307 Arctic Boulevard
Anchorage, AK 99503
Phone: 907-258-2155
Fax: 907-258-6634

7/12/2013

Municipality of Anchorage - Public Works
PO Box 196650
4700 Elmore
Anchorage, AK 99519
Attn: Kristi Bischofberger

Work Order #: A1306476
Date: 7/12/2013
Work ID: APDES Snow Site Evaluation
Date Received: 6/27/2013
Proj #: none

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
A1306476-01	TDR-Strm	A1306476-02	TDR-WR1
A1306476-03	SPR-WR2	A1306476-04	SPR-DPND1

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Claire K. Toon

Claire Toon
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Group, LLC - Anchorage

Work Order: A1306476

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

SAMPLE RECEIPT:
Four (4) samples were received on 6/27/2013 2:26:00 PM, at a temperature of 13.8°C, at Analytica-Anchorage. The samples were received in good condition and in order per chain of custody.

Comments: The samples were received on ice directly from the sampling site.
The samples were transferred for chloride analysis to Analytica Environmental Laboratories (AEL), 12189 Pennsylvania St., Thornton, Colorado 80241, where they were received at a temperature of 2.9°C, in good condition and in order per chain of custody on 7/2/2013.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below.

All analytical results contained in this report have been reviewed under Analytica's internal quality assurance and quality control program. Any deviations in quality control parameters for specific analyses are noted in the following text. A complete quality assurance report, including laboratory control, matrix spike, and sample duplicate recoveries is kept on file in our office and is available upon request.

All method specifications were met for the following tests, unless otherwise noted:

Test Method: Inorganic Anions by Ion Chromatography - Anions by IC2 - Surface Water

Test Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TSS - Surface Water

SAMPLE PREPARATION ISSUES AND OBSERVATIONS:
The entire TSS sample volume was filtered for each sample.

Test Method: SM4500-H-B Electrometric pH Method - pH - Surface Water

HOLDING TIMES:
pH is a field test requiring immediate analysis. This analysis was performed as soon as possible upon laboratory receipt.

HOLD TIMES MISSED:
Sample SPR-DPND1,A1306476-04A
Sampled: 6/27/2013 2:02:00 PM, Prepped: 6/27/2013 3:40:00 PM

Sampled: 6/27/2013 2:02:00 PM, Analyzed: 6/27/2013 3:40:00 PM

Regulatory hold time: 0 Hrs

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1306476

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **TDR-Strm**

Matrix: Surface Water

Collection Date: 6/27/2013 12:50:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1306476-01A	Analysis Date:	7/1/2013 3:00:00PM
Prep Date:	7/1/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130708013		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**1.27**		mg/L	0.98	0.49	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1306476-01B	Analysis Date:	7/11/2013 6:03:00PM
Prep Date:	7/11/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	15.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	1
Prep Batch Number:	T130712003		
Report Basis:	As Received	Analyst Initials:	TE
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**30.7**		mg/L	0.50	0.071	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1306476

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **TDR-WR1**

Matrix: Surface Water

Collection Date: 6/27/2013 1:04:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1306476-02A	Analysis Date:	7/1/2013 3:00:00PM
Prep Date:	7/1/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130708013		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**199**		mg/L	1.0	0.52	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1306476-02B	Analysis Date:	7/11/2013 7:01:00PM
Prep Date:	7/11/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	19.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	2
Prep Batch Number:	T130712003		
Report Basis:	As Received	Analyst Initials:	TE
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**18.8**		mg/L	1.0	0.14	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1306476

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **SPR-WR2**

Matrix: Surface Water

Collection Date: 6/27/2013 1:30:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1306476-03A	Analysis Date:	7/1/2013 3:00:00PM
Prep Date:	7/1/2013	Instrument:	SCALE
Analytical Method ID:	SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS	File Name:	
Prep Method ID:	2540D	Dilution Factor:	0
Prep Batch Number:	A130708013		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**6.09**		mg/L	0.95	0.48	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1306476-03B	Analysis Date:	7/11/2013 7:15:00PM
Prep Date:	7/11/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	20.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	1
Prep Batch Number:	T130712003		
Report Basis:	As Received	Analyst Initials:	TE
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**9.98**		mg/L	0.50	0.071	1

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1306476

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **SPR-DPND1**

Matrix: Surface Water

Collection Date: 6/27/2013 2:02:00PM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1306476-04A	Analysis Date:	6/27/2013 3:40:00PM
Prep Date:	6/27/2013	Instrument:	Probe
Analytical Method ID:	SM4500-H-B Electrometric pH Method - pH	File Name:	
Prep Method ID:	4500-H-B	Dilution Factor:	1
Prep Batch Number:	A130710008		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**8.6**		pH	0.0	0.0	1

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **150,549** **Lab Project Number:** **A1306476**

Prep Date: 7/1/2013

Lab Method Blank Id: A130708013-MB
Prep Batch ID: A130708013
Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - T

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
A1306476-01A	TDR-Strm		7/1/2013 3:00:00PM
A1306476-02A	TDR-WR1		7/1/2013 3:00:00PM
A1306476-03A	SPR-WR2		7/1/2013 3:00:00PM
A1307019-08A	Batch QC		7/1/2013 3:00:00PM
A130708013-LCS	LCS		7/1/2013 3:00:00PM
A1307019-08A-DUP	DUP		7/1/2013 3:00:00PM

Prep Date: 7/11/2013

Lab Method Blank Id: T130712003-MB
Prep Batch ID: T130712003
Method: Inorganic Anions by Ion Chromatography - Anions by IC2

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T130712003-LCS	LCS	12.0000.XLS	7/11/2013 5:20:00PM
A1306476-01B	TDR-Strm	15.0000.XLS	7/11/2013 6:03:00PM
A1306476-01B-DUP	DUP	16.0000.XLS	7/11/2013 6:18:00PM
A1306476-01B-MS	MS	17.0000.XLS	7/11/2013 6:32:00PM
A1306476-01B-MSD	MSD	18.0000.XLS	7/11/2013 6:47:00PM
A1306476-02B	TDR-WR1	19.0000.XLS	7/11/2013 7:01:00PM
A1306476-03B	SPR-WR2	20.0000.XLS	7/11/2013 7:15:00PM

Workorder (SDG): A1306476

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

ND = Not Detected at or above the Reporting Limit
NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

LOW = Recovery is below Lower Control Limit
HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

B = Analyte was detected in the laboratory method blank
J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
W = Post digestion spike did not meet criteria
S = Reported value determined by the Method of Standard Additions (MSA)

Several ways of defining the limit of detection and quantitation are prevalent in the laboratory industry and may appear in Analytica reports. These include the following:

MRL = "minimum reporting level", from the EPA Safe Drinking Water program (SDW)
PQL = "practical quantitation limit", from SW-846
EQL = "estimated quantitation limit", from SW-846
LOQ = "limit of quantitation", from a number of authoritative sources

In Analytica's work, all of these terms have the same meaning, equivalent to the EPA definition of the MRL. This reporting level is supported by a satisfactory calibration data point which is at that level or lower, and also is supported by a method detection limit (MDL) determined by the procedure in 40CFR. The MDL is lower than the MRL and represents an estimate of the level where positive detections have a 99% probability of being real, but where quantitation accuracy is unknown.

The MRL as defined by Analytica is the lowest demonstrated point of known quantitation accuracy.
The MRL should not be confused with the MCL, which is the EPA-defined "maximum contaminant level" allowed for certain regulated targets under specific regulations, such as the National Primary Drinking Water Regulations. Normally, the MRL is set at a level which is much lower than the MCL in order to ensure that levels are well below those limits. Not all target analytes have MCL levels established.

Other Flags may be applied. See Case Narrative for Description

Workorder (SDG): A1306476

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

A1306476

TestPkgName	Basis	# Sig Figs	Reporting Limit
2540D/2540D (Aqueous) - TSS	As Received	3	Report to PQL
300.0/300.0 (Aqueous) - Anions by IC2	As Received	3	Report to PQL
4500-H-B/4500-H-B (Aqueous) - pH	As Received	2	Report to PQL

Analytica Chain of Custody Form

ANALYTICA GROUP

12189 Pennsylvania St. Thornton, CO 80241 (303) 469-8868 (303) 469-5254 fax
4307 Arctic Boulevard Anchorage, AK 99503 (907) 258-2155 (907) 258-6634 fax
475 Hall St. Fairbanks, AK 99701 (907) 456-3116 (907) 456 3125 fax
1203 W. Parks HWY Wasilla, AK 99654 (907) 373-5440

Page 1 of 1

Chain of Custody No: 086078

Client Name & Address: MOA - WMS

Report to: Scott R Wheaton

Phone No: 343-8117

Fax No:

E-mail: wheatonsr@muni.org

Special Instructions/Comments:

Public Water System (PWS) ID#:

Project Name: Sno Site Evaluation

Turnaround Time for Results (TAT)

___ Standard ___ Expedited (< 10 days, prior authorization required)
___ Routine ___ Non-Routine (please specify due date below; add'l charges may apply)

Requested Due Date for Results:

Section to be Completed by Analytica

Quote ID: LGN: A1306476

Account #: Check Credit Card

Invoice to Name & Address:

P.O. or Contract No:

Kit Prep/Shipping Charge: $

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	TSS-SSC	Cl⁻	pH					Field Preserved	Field Filtered	MS/MSD ?
TDR_Stem	6/27/2013	1250	SW	2	✓	✓								
TDR_WR1	↓	1304	↓	2	✓	✓								
SPR_WR2	↓	1330	↓	2	✓	✓								
SPR_DPND1	↓	1402	↓	1			✓							

(Each analysis column includes Lot #: / Pres: fields.)

Relinquished by:	Date	Time	Received by:	Date	Time
[signature]	6/27/2013	1426	[signature]	6/27/13	1426
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Name of Sampler: (printed)

Section to be completed by Analytica

	THO	ANC	FBKS	WAS
Condition of Custody Seal?		N/A		
Initialed by:		—		
Temp/Loc:		13.8*		
Thermo ID#:		94969		
Shipped Via:		Client		

* Samples rec'd directly from sampling site

Version 2.0

ANALYTICA
Environmental Laboratories

Analytica Group, LLC-Anchorage
4307 Arctic Boulevard
Anchorage, AK 99503
Phone: 907-258-2155
Fax: 907-258-6634

7/18/2013

Municipality of Anchorage - Public Works
PO Box 196650
4700 Elmore
Anchorage, AK 99519
Attn: Kristi Bischofberger

Work Order #: A1307115
Date: 7/18/2013
Work ID: APDES Snow Site Evaluation
Date Received: 7/5/2013
Proj #: none

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
A1307115-01	TDR-WR1	A1307115-02	SPR-WR1

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Claire K. Toon

Claire Toon
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Group, LLC - Anchorage
Work Order: A1307115

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

SAMPLE RECEIPT:
Two (2) samples were received on 7/5/2013 10:13:00 AM, at a temperature of 13.2°C, at Analytica-Anchorage. The samples were received in good condition and in order per chain of custody.

The samples were transferred for chloride analysis to Analytica Environmental Laboratories (AEL), 12189 Pennsylvania St., Thornton, Colorado 80241, where they were received at a temperature of 4.7°C, in good condition and in order per chain of custody on 7/9/2013.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below.

All analytical results contained in this report have been reviewed under Analytica's internal quality assurance and quality control program. Any deviations in quality control parameters for specific analyses are noted in the following text. A complete quality assurance report, including laboratory control, matrix spike, and sample duplicate recoveries is kept on file in our office and is available upon request.

All method specifications were met for the following tests, unless otherwise noted:

Test Method: Inorganic Anions by Ion Chromatography - Anions by IC2 - Surface Water

Test Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TSS - Surface Water

SAMPLE PREPARATION ISSUES AND OBSERVATIONS:
The entire TSS sample volume was filtered for this sample.

Test Method: SM4500-H-B Electrometric pH Method - pH - Surface Water

HOLDING TIMES:
pH is a field test requiring immediate analysis. This analysis was performed as soon as possible upon laboratory receipt.

HOLD TIMES MISSED:
Sample SPR-WR1,A1307115-02B
Sampled: 7/5/2013 8:24:00 AM, Prepped: 7/5/2013 3:10:00 PM
Sampled: 7/5/2013 8:24:00 AM, Analyzed: 7/5/2013 3:10:00 PM

Regulatory hold time: 0 Hrs

Detailed Analytical Report

Analytica Group, LLC - Anchorage

Workorder (SDG): A1307115

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: **Client Sample Report**

Client Sample Name: **TDR-WR1**

Matrix: Surface Water

Collection Date: 7/5/2013 7:52:00AM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number: A1307115-01A
Analysis Date: 7/8/2013 2:30:00PM
Prep Date: 7/8/2013
Instrument: SCALE
Analytical Method ID: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - TS
File Name:
Prep Method ID: 2540D
Dilution Factor: 0
Prep Batch Number: A130710016
Report Basis: As Received
Analyst Initials: MC
Sample prep wt./vol: 1.00 ml
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Suspended Solids		**30.0**		mg/L	1.1	0.55	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: A1307115-01B
Analysis Date: 7/16/2013 2:19:00PM
Prep Date: 7/16/2013
Instrument: IC_2
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC2
File Name: 20.0000.XLS
Prep Method ID: 300.0
Dilution Factor: 2
Prep Batch Number: T130716021
Report Basis: As Received
Analyst Initials: TE
Sample prep wt./vol: 4.00 ml
Prep Extract Vol: 4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**21.1**		mg/L	1.0	0.14	1

Detailed Analytical Report Analytica Group, LLC - Anchorage

Workorder (SDG): A1307115

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **SPR-WR1**

Matrix: Surface Water Collection Date: 7/5/2013 8:24:00AM

The following test was conducted by: Analytica - Anchorage

Lab Sample Number:	A1307115-02B	Analysis Date:	7/5/2013 3:10:00PM
Prep Date:	7/5/2013	Instrument:	Probe
Analytical Method ID:	SM4500-H-B Electrometric pH Method - pH	File Name:	
Prep Method ID:	4500-H-B	Dilution Factor:	1
Prep Batch Number:	A130710011		
Report Basis:	As Received	Analyst Initials:	MC
Sample prep wt./vol:	1.00 ml	Prep Extract Vol:	1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**7.3**		pH	0.0	0.0	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	A1307115-02A	Analysis Date:	7/16/2013 2:33:00PM
Prep Date:	7/16/2013	Instrument:	IC_2
Analytical Method ID:	Inorganic Anions by Ion Chromatography - Anions by IC2	File Name:	21.0000.XLS
Prep Method ID:	300.0	Dilution Factor:	2
Prep Batch Number:	T130716021		
Report Basis:	As Received	Analyst Initials:	TE
Sample prep wt./vol:	4.00 ml	Prep Extract Vol:	4.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**9.66**		mg/L	1.0	0.14	1

Workorder (SDG): A1307115

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **150,789** **Lab Project Number:** **A1307115**

Prep Date: 7/8/2013

Lab Method Blank Id: A130710016-MB
Prep Batch ID: A130710016
Method: SM2540D - Solids, Total Suspended Solids Dried at 103-105 C - T

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
A1307091-08A	Batch QC		7/8/2013 2:30:00PM
A1307115-01A	TDR-WR1		7/8/2013 2:30:00PM
A130710016-LCS	LCS		7/8/2013 2:30:00PM
A1307091-08A-DUP	DUP		7/8/2013 2:30:00PM

Prep Date: 7/16/2013

Lab Method Blank Id: T130716021-MB
Prep Batch ID: T130716021
Method: Inorganic Anions by Ion Chromatography - Anions by IC2

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T130716021-LCS	LCS	12.0000.XLS	7/16/2013 12:23:00PM
A1307237-01C	Batch QC	15.0000.XLS	7/16/2013 1:07:00PM
A1307237-01C-DUP	DUP	16.0000.XLS	7/16/2013 1:21:00PM
A1307237-01C-MS	MS	17.0000.XLS	7/16/2013 1:35:00PM
A1307237-01C-MSD	MSD	18.0000.XLS	7/16/2013 1:50:00PM
A1307115-01B	TDR-WR1	20.0000.XLS	7/16/2013 2:19:00PM
A1307115-02A	SPR-WR1	21.0000.XLS	7/16/2013 2:33:00PM

Workorder (SDG): A1307115

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

- ND = Not Detected at or above the Reporting Limit
- NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

- LOW = Recovery is below Lower Control Limit
- HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
- E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

- B = Analyte was detected in the laboratory method blank
- J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

- J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
- W = Post digestion spike did not meet criteria
- S = Reported value determined by the Method of Standard Additions (MSA)

Several ways of defining the limit of detection and quantitation are prevalent in the laboratory industry and may appear in Analytica reports. These include the following:

- MRL = "minimum reporting level", from the EPA Safe Drinking Water program (SDW)
- PQL = "practical quantitation limit", from SW-846
- EQL = "estimated quantitation limit", from SW-846
- LOQ = "limit of quantitation", from a number of authoritative sources

In Analytica's work, all of these terms have the same meaning, equivalent to the EPA definition of the MRL. This reporting level is supported by a satisfactory calibration data point which is at that level or lower, and also is supported by a method detection limit (MDL) determined by the procedure in 40CFR. The MDL is lower than the MRL and represents an estimate of the level where positive detections have a 99% probability of being real, but where quantitation accuracy is unknown.

The MRL as defined by Analytica is the lowest demonstrated point of known quantitation accuracy.
The MRL should not be confused with the MCL, which is the EPA-defined "maximum contaminant level" allowed for certain regulated targets under specific regulations, such as the National Primary Drinking Water Regulations. Normally, the MRL is set at a level which is much lower than the MCL in order to ensure that levels are well below those limits. Not all target analytes have MCL levels established.

Other Flags may be applied. See Case Narrative for Description

Workorder (SDG): A1307115

Project: **APDES Snow Site Evaluation**

Client: **Municipality of Anchorage - Public Works**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

A1307115

TestPkgName	Basis	# Sig Figs	Reporting Limit
2540D/2540D (Aqueous) - TSS	As Received	3	Report to PQL
300.0/300.0 (Aqueous) - Anions by IC2	As Received	3	Report to PQL
4500-H-B/4500-H-B (Aqueous) - pH	As Received	2	Report to PQL

Analytica Chain of Custody Form

Page 1 of 1

ANALYTICA GROUP

12189 Pennsylvania St.
Thornton, CO 80241
(303) 469-8868
(303) 469-5254 fax

4307 Arctic Boulevard
Anchorage, AK 99503
(907) 258-2155
(907) 258-6634 fax

475 Hall St.
Fairbanks, AK 99701
(907) 456-3116
(907) 456 3125 fax

1203 W. Parks HWY
Wasilla, AK 99654
(907) 373-5440

Chain of Custody No: 085134

Client Name & Address: MOA - WMS

Report to: Scott R Wheaton

Phone No: 343-8117

Fax No:

E-mail: WheatonSR@Muni.org

Special Instructions/Comments: Samples received on ice KHa 7/5/13

Kit Prep/Shipping Charge: $

Public Water System (PWS) ID#:

Project Name: Snow Site Evaluation

Turnaround Time for Results (TAT)

___ Standard ___ Expedited (< 10 days, prior authorization required)
___ Routine ___ Non-Routine (please specify due date below; add'l charges may apply)

Requested Due Date for Results:

Section to be Completed by Analytica

Quote ID:

LGN: A1307115

Account #: ___ Check ___ Credit Card ___

Invoice to Name & Address:

P.O. or Contract No:

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	TSS/SSC (Lot #: / Pres:)	Cl⁻ (Lot #: / Pres:)	pH (Lot #: / Pres:)	Lot #: / Pres:	Lot #: / Pres:	Lot #: / Pres:	Lot #: / Pres:	Field Preserved	Field Filtered	MS/MSD ?
TDB-WR1	7/5/2013	0752	SW	2	✓	✓								
SPR-WR1	〃	0824	SW	2		✓	✓							

(Requested Analysis/Method)

Relinquished by:	Date	Time	Received by:	Date	Time
[signature]	7/5/2013	1013	K Garrells	7/5/13	1013

Name of Sampler: (printed)

Section to be completed by Analytica

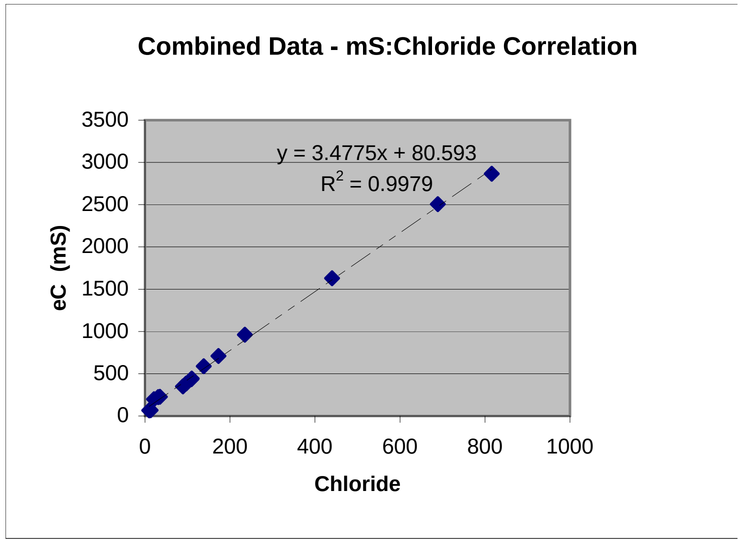
	THO	ANC	FBKS	WAS
Condition of Custody Seal?		Absent		
Initialed by:		—		
Temp/Loc:		13.2		
Thermo ID#:		94969		
Shipped Via:		Client		

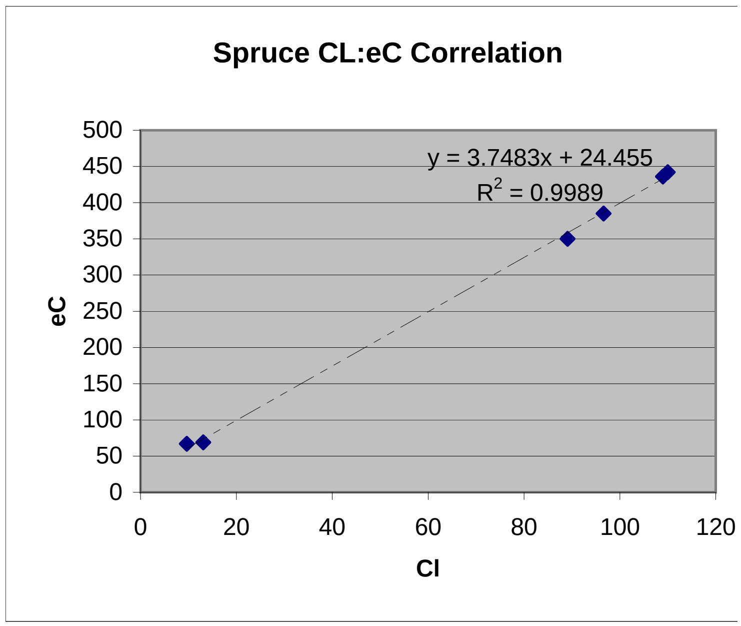
Version 2.0

SampDate	StnID	Cl	eC
5/13/2013	Spr_Wr1	96.6	385
5/13/2013	Tdr_Wr1	816	2865
5/13/2013	Tdr_Wr3	440	1630
5/16/2013	Spr_Wr1	109	436
5/16/2013	Spr_Wr2	110	442
5/16/2013	Tdr_Wr1	689	2507
5/23/2013	Spr_Wr2	89.1	350
5/23/2013	Tdr_Dpnd1	173	710
5/23/2013	Tdr_Mpnd1	30.9	223
5/23/2013	Tdr_Wr1	235	962
5/30/2013	Tdr_Strm	138	589
6/13/2013	Spr_Wr2	13.1	69
6/13/2013	Tdr_Wr1	35.2	227
7/5/2013	Spr_Wr1	9.66	67
7/5/2013	Tdr_Wr1	21.1	199

m	b
0.286951	-22.69816

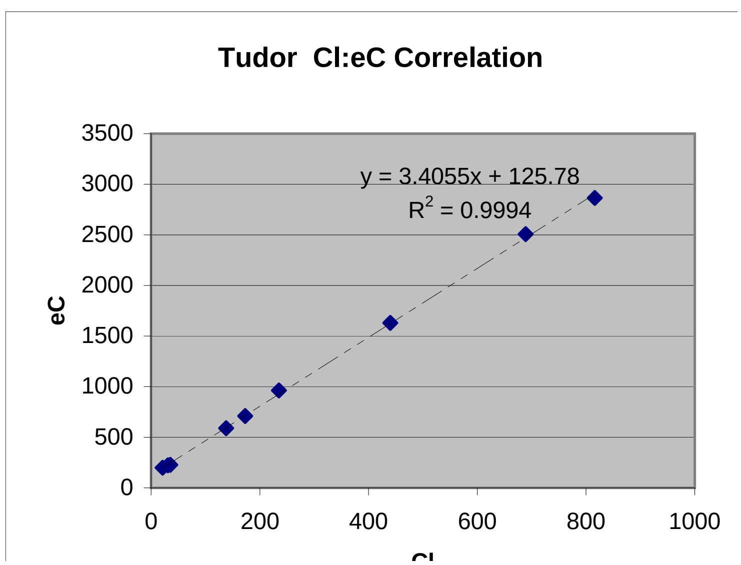
y=mx+b





5/13/2013	Spr_Wr1	96.6	385
5/16/2013	Spr_Wr1	109	436
5/16/2013	Spr_Wr2	110	442
5/23/2013	Spr_Wr2	89.1	350
6/13/2013	Spr_Wr2	13.1	69
7/5/2013	Spr_Wr1	9.66	67

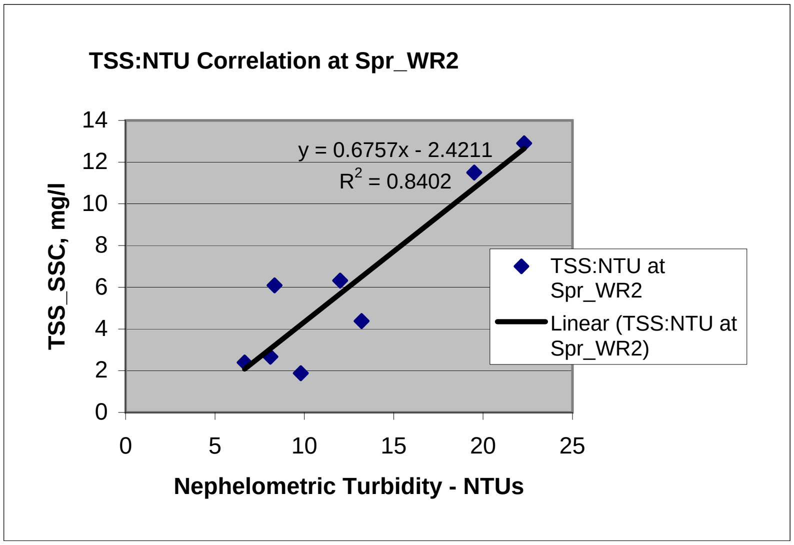
0.266492 -6.439038



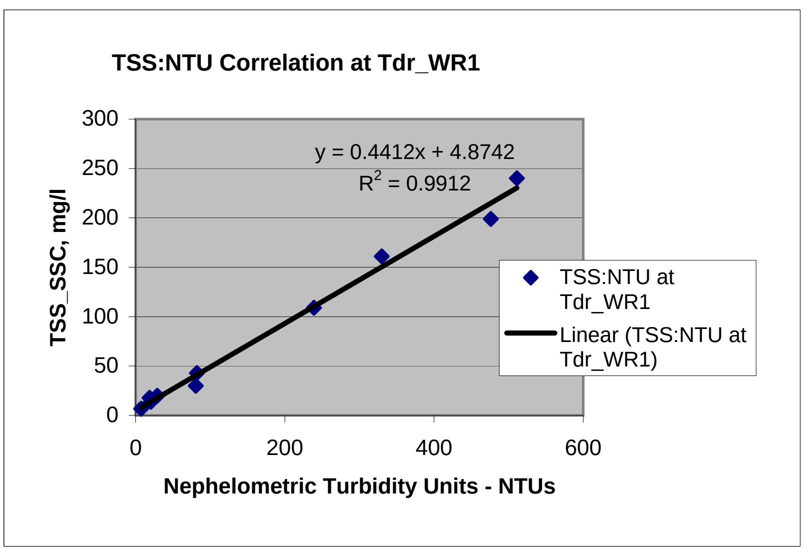
5/13/2013	Tdr_Wr1	816	2865
5/13/2013	Tdr_Wr3	440	1630
5/16/2013	Tdr_Wr1	689	2507
5/23/2013	Tdr_Dpnd1	173	710
5/23/2013	Tdr_Mpnd1	30.9	223
5/23/2013	Tdr_Wr1	235	962
5/30/2013	Tdr_Strm	138	589
6/13/2013	Tdr_Wr1	35.2	227
7/5/2013	Tdr_Wr1	21.1	199

0.293479 -36.751

ParType	SampDate	StnID	ParVal	ParType	SampDate	StnID	ParVal
TSS_SSC	5/10/2013	Spr_Wr2	1.88	NTUs	5/10/2013	Spr_Wr2	9.80000019
TSS_SSC	5/23/2013	Spr_Wr2	2.3900001	NTUs	5/23/2013	Spr_Wr2	6.65999985
TSS_SSC	5/16/2013	Spr_Wr2	2.67000008	NTUs	5/16/2013	Spr_Wr2	8.10000038
TSS_SSC	6/6/2013	Spr_Wr2	4.38000011	NTUs	6/6/2013	Spr_Wr2	13.1999998
TSS_SSC	6/27/2013	Spr_Wr2	6.09000015	NTUs	6/27/2013	Spr_Wr2	8.32999992
TSS_SSC	5/30/2013	Spr_Wr2	6.32000017	NTUs	5/30/2013	Spr_Wr2	12
TSS_SSC	6/20/2013	Spr_Wr2	11.5	NTUs	6/20/2013	Spr_Wr2	19.5
TSS_SSC	6/13/2013	Spr_Wr2	12.8999996	NTUs	6/13/2013	Spr_Wr2	22.2999992



ParType	SampDate	StnID	ParVal	ParType	SampDate	StnID	ParVal
TSS_SSC	5/16/2013	Tdr_Wr1	6.80000019	NTUs	5/16/2013	Tdr_Wr1	7.30999994
TSS_SSC	5/23/2013	Tdr_Wr1	13.6999998	NTUs	5/23/2013	Tdr_Wr1	20.3999996
TSS_SSC	5/10/2013	Tdr_Wr1	17.7999992	NTUs	5/10/2013	Tdr_Wr1	18.7000008
TSS_SSC	5/13/2013	Tdr_Wr1	20	NTUs	5/13/2013	Tdr_Wr1	29
TSS_SSC	7/5/2013	Tdr_Wr1	30	NTUs	7/5/2013	Tdr_Wr1	80.5
TSS_SSC	5/30/2013	Tdr_Wr1	43	NTUs	5/30/2013	Tdr_Wr1	82.1999969
TSS_SSC	6/6/2013	Tdr_Wr1	109	NTUs	6/6/2013	Tdr_Wr1	239
TSS_SSC	6/13/2013	Tdr_Wr1	161	NTUs	6/13/2013	Tdr_Wr1	330
TSS_SSC	6/27/2013	Tdr_Wr1	199	NTUs	6/27/2013	Tdr_Wr1	476
TSS_SSC	6/20/2013	Tdr_Wr1	240	NTUs	6/20/2013	Tdr_Wr1	511



2013 Vswale small-sample Wilcoxon Rank-Sum

Spruce Eastern Wetlands

Chloride Surrogate Measures (Conductivity converted)

StnID	SampDate	ClRegress
	5/10/2013	
	5/13/2013	
	5/16/2013	
	5/23/2013	
	5/28/2013	
	5/30/2013	
Spr_Wet0	6/6/2013	22
Spr_Wet0	6/13/2013	12
Spr_Wet0	6/20/2013	8
Spr_Wet0	6/27/2013	19
Spr_Wet0	7/5/2013	15
Spr_Wet0	7/12/2013	10
	7/19/2013	
	5/10/2013	
	5/13/2013	
	5/16/2013	
	5/23/2013	
	5/28/2013	
	5/30/2013	
	6/6/2013	
Spr_Wet1	6/13/2013	14
Spr_Wet1	6/20/2013	12
Spr_Wet1	6/27/2013	8
Spr_Wet1	7/5/2013	10
Spr_Wet1	7/12/2013	10
	7/19/2013	
	5/10/2013	
	5/13/2013	
	5/16/2013	
	5/23/2013	
	5/28/2013	
	5/30/2013	
	6/6/2013	
Spr_Wet2	6/13/2013	21
Spr_Wet2	6/20/2013	21
Spr_Wet2	6/27/2013	13
Spr_Wet2	7/5/2013	10
Spr_Wet2	7/12/2013	12
	7/19/2013	

Spr_Wet5
6/27/2013
120

Spruce East Wetlands pairs

6/13/2013	Spr_Wet0	12	A
6/20/2013	Spr_Wet0	8	B
6/27/2013	Spr_Wet0	19	
7/5/2013	Spr_Wet0	15	
7/12/2013	Spr_Wet0	10	
	Spr_Wet1	14	
	Spr_Wet1	12	
	Spr_Wet1	8	
	Spr_Wet1	10	
	Spr_Wet1	10	
	Spr_Wet2	21	
	Spr_Wet2	21	
	Spr_Wet2	13	
	Spr_Wet2	10	
	Spr_Wet2	12	
	Spr_Wet3	9	
	Spr_Wet3	17	
	Spr_Wet3	13	
	Spr_Wet3	12	
	Spr_Wet3	10	

Transposed East Wetland Pairs

Spr_Wet0	Spr_Wet0	Spr_Wet0	Spr_Wet0	Spr_Wet0	Spr_Wet0
6/6/2013	6/13/2013	6/20/2013	6/27/2013	7/5/2013	7/12/2013
22	12	8	19	15	10
	Spr_Wet1	Spr_Wet1	Spr_Wet1	Spr_Wet1	Spr_Wet1
	6/13/2013	6/20/2013	6/27/2013	7/5/2013	7/12/2013
	14	12	8	10	10
	Spr_Wet2	Spr_Wet2	Spr_Wet2	Spr_Wet2	Spr_Wet2
	6/13/2013	6/20/2013	6/27/2013	7/5/2013	7/12/2013
	21	21	13	10	12
	Spr_Wet3	Spr_Wet3	Spr_Wet3	Spr_Wet3	Spr_Wet3
	6/13/2013	6/20/2013	6/27/2013	7/5/2013	7/12/2013
	9	17	13	12	10
	Spr_Wet4	Spr_Wet4			
	6/13/2013	6/20/2013			
	17	17			

	5/10/2013	
	5/13/2013	
	5/16/2013	
	5/23/2013	
	5/28/2013	
	5/30/2013	
	6/6/2013	
Spr_Wet3	6/13/2013	9
Spr_Wet3	6/20/2013	17
Spr_Wet3	6/27/2013	13
Spr_Wet3	7/5/2013	12
Spr_Wet3	7/12/2013	10
	7/19/2013	
	5/10/2013	
	5/13/2013	
	5/16/2013	
	5/23/2013	
	5/28/2013	
	5/30/2013	
	6/6/2013	
Spr_Wet4	6/13/2013	17
Spr_Wet4	6/20/2013	17
	6/27/2013	
	7/5/2013	
	7/12/2013	
	7/19/2013	
	5/10/2013	
	5/13/2013	
	5/16/2013	
	5/23/2013	
	5/28/2013	
	5/30/2013	
	6/6/2013	
	6/13/2013	
	6/20/2013	
Spr_Wet5	6/27/2013	120
	7/5/2013	
	7/12/2013	
	7/19/2013	

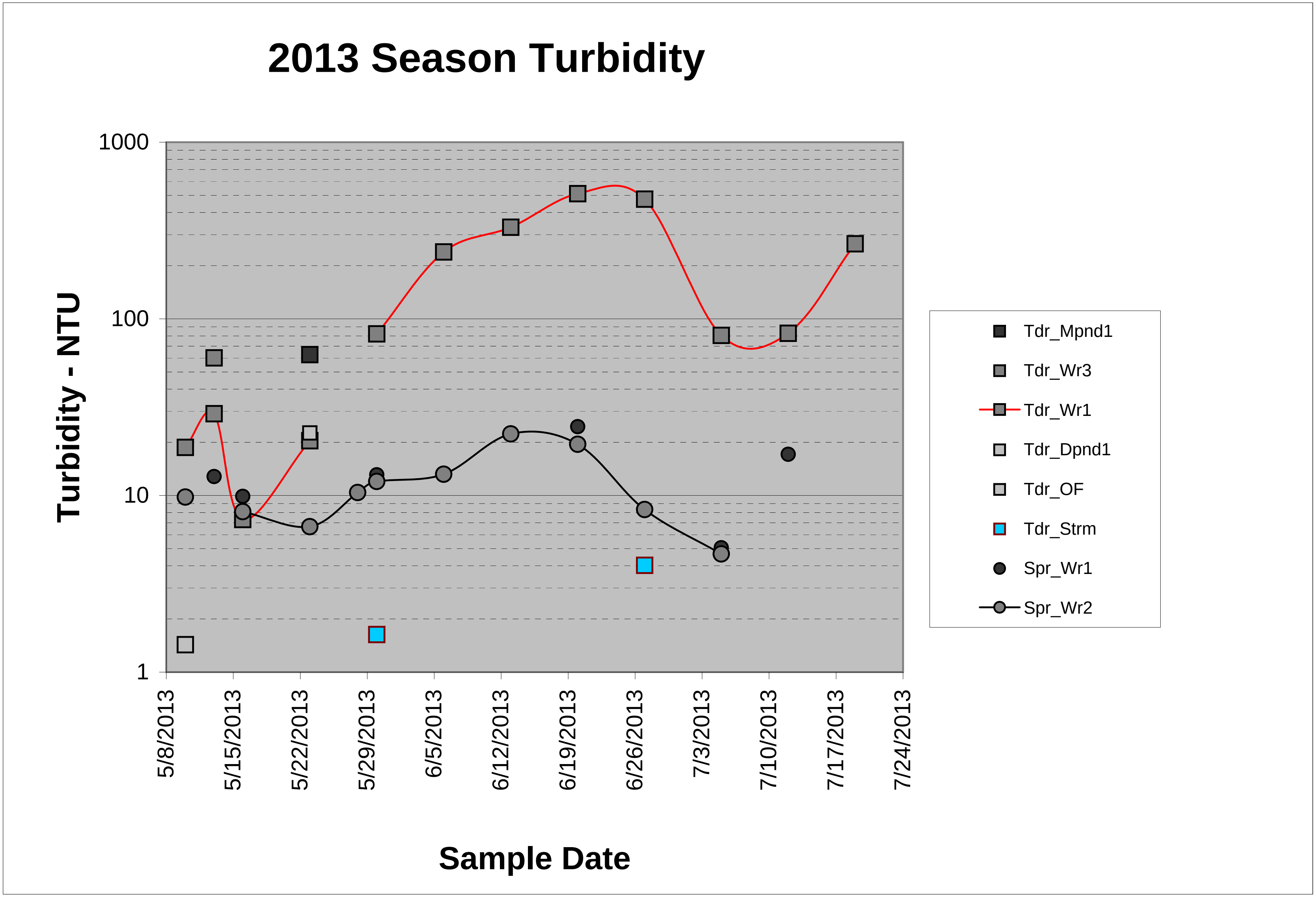
Small-Sample Wilcoxon Rank-Sum Test

Wet0/Wet1

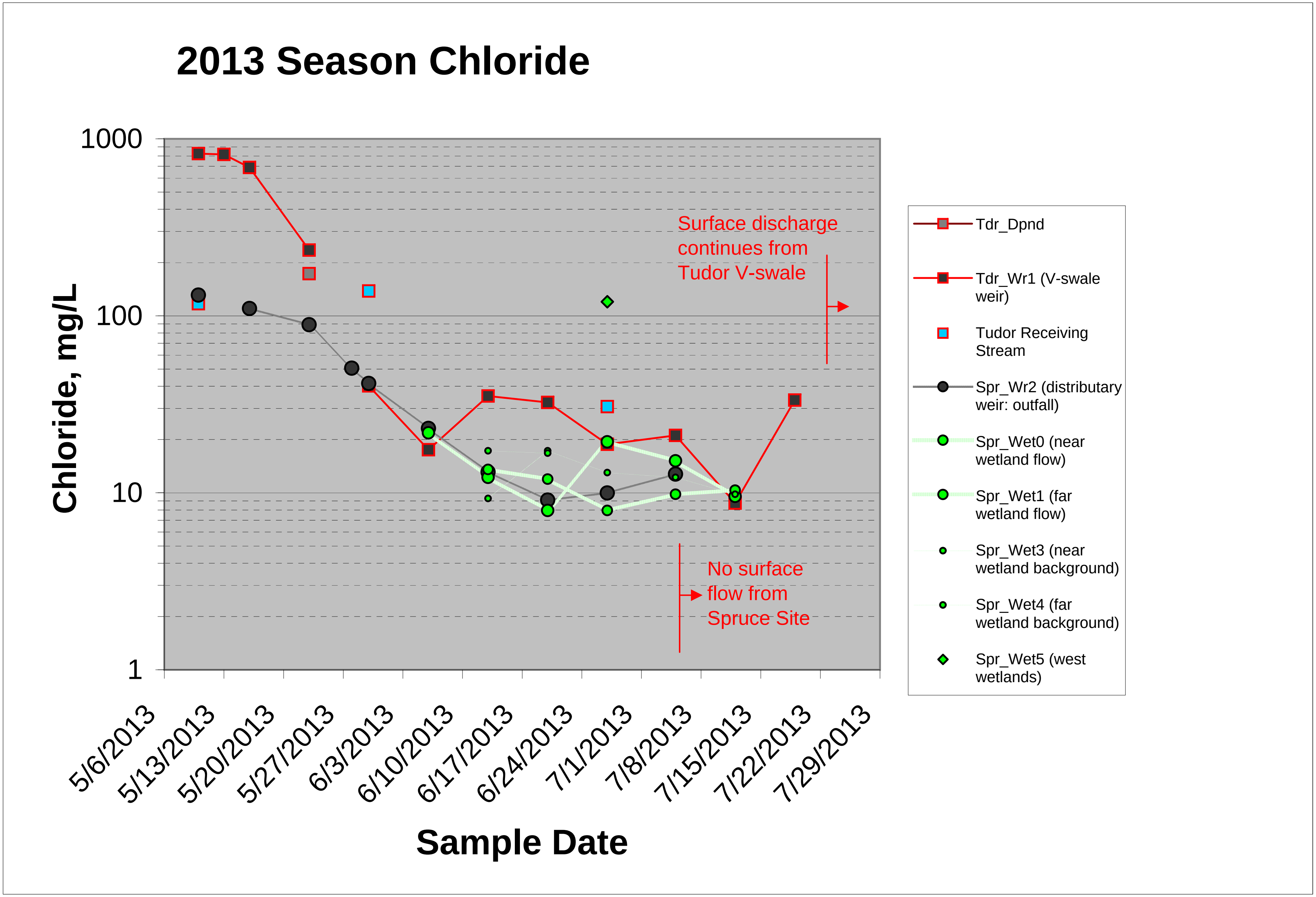
Stn	Cl	rank	rank at ties	
Spr_Wet0	8	1	1.5	
Spr_Wet1	8	2	1.5	
Spr_Wet0	10	3	4	
Spr_Wet1	10	4	4	
Spr_Wet1	10	5	4	
Spr_Wet1	12	6	6.5	
Spr_Wet0	12	7	6.5	
Spr_Wet1	14	8	8	
Spr_Wet0	15	9	9	
Spr_Wet0	19	10	10	
	sum total	55		
Wa	Wb			
sum Wet0	sum Wet1			
31	24	a, b =5	H1: A>B	p>0.20

Wet0/Wet3

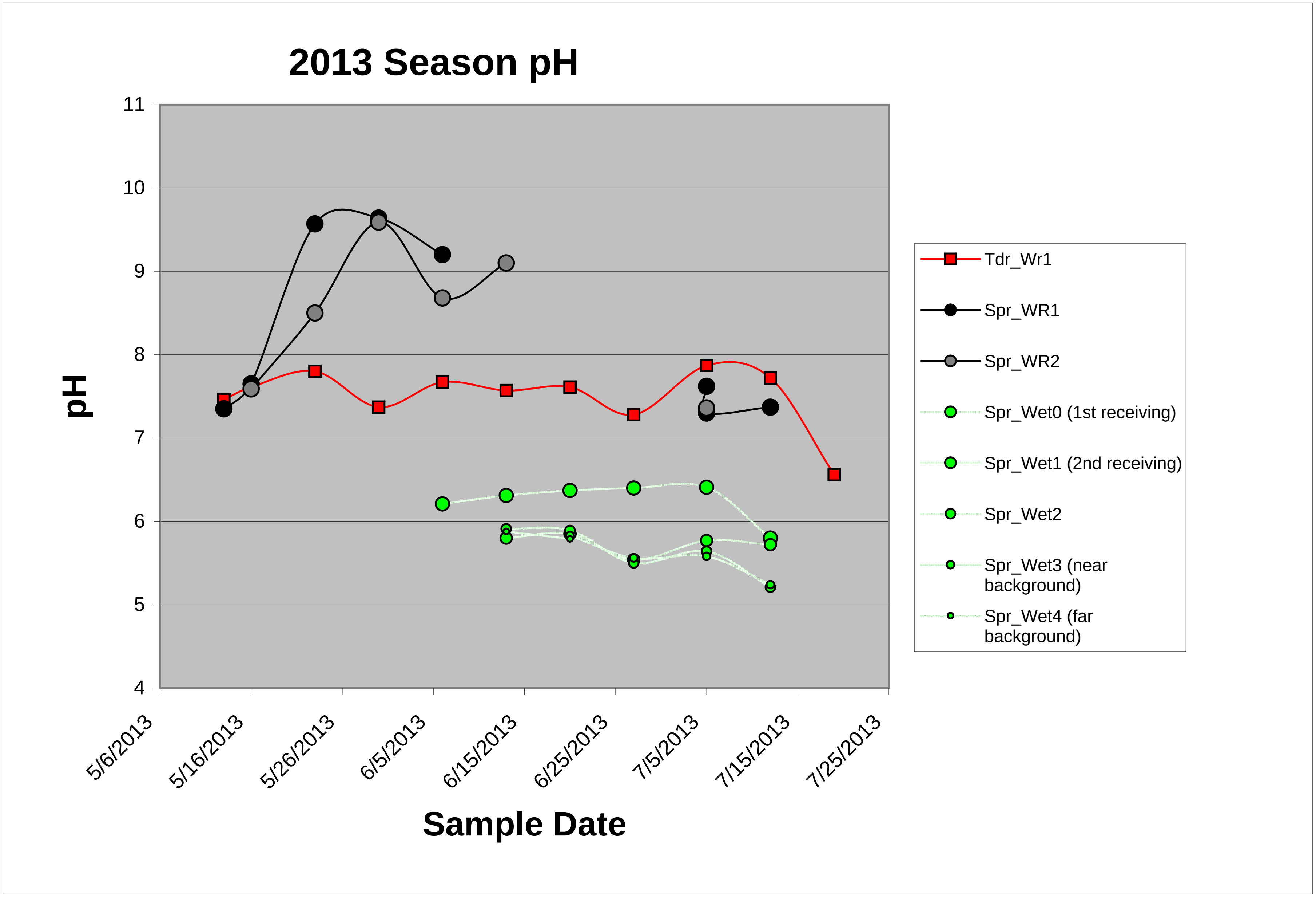
		rank at ties		
Spr_Wet0	8	1		
Spr_Wet3	9	2		
Spr_Wet0	10	3.5		
Spr_Wet3	10	3.5		
Spr_Wet0	12	5.5		
Spr_Wet3	12	5.5		
Spr_Wet3	13	7		
Spr_Wet0	15	8		
Spr_Wet3	17	9		
Spr_Wet0	19	10		
Wa	Wb			
Sum Wet0	Sum Wet3	a, b = 5		
28	27		H1: A>B	p>>0.20



2013 Season Turbidity
Turbidity - NTU
1000
100
10
1
5/8/2013
5/15/2013
5/22/2013
5/29/2013
6/5/2013
6/12/2013
6/19/2013
6/26/2013
7/3/2013
7/10/2013
7/17/2013
7/24/2013
Sample Date
Tdr_Mpnd1
Tdr_Wr3
Tdr_Wr1
Tdr_Dpnd1
Tdr_OF
Tdr_Strm
Spr_Wr1
Spr_Wr2



2013 Season Chloride
Chloride, mg/L
1000
100
10
1
5/6/2013
5/13/2013
5/20/2013
5/27/2013
6/3/2013
6/10/2013
6/17/2013
6/24/2013
7/1/2013
7/8/2013
7/15/2013
7/22/2013
7/29/2013
Sample Date
Surface discharge continues from Tudor V-swale
No surface flow from Spruce Site
Tdr_Dpnd
Tdr_Wr1 (V-swale weir)
Tudor Receiving Stream
Spr_Wr2 (distributary weir: outfall)
Spr_Wet0 (near wetland flow)
Spr_Wet1 (far wetland flow)
Spr_Wet3 (near wetland background)
Spr_Wet4 (far wetland background)
Spr_Wet5 (west wetlands)


2013 Season pH
pH
11
10
9
8
7
6
5
4
5/6/2013
5/16/2013
5/26/2013
6/5/2013
6/15/2013
6/25/2013
7/5/2013
7/15/2013
7/25/2013
Sample Date
Tdr_Wr1
Spr_WR1
Spr_WR2
Spr_Wet0 (1st receiving)
Spr_Wet1 (2nd receiving)
Spr_Wet2
Spr_Wet3 (near background)
Spr_Wet4 (far background)

ANCHORAGE SNOW DISPOSAL SITES:
2013 EVALUATION

Document No.: WMP ARr14002
WMS Project No.: 95004

Appendix E – 2013 V-Swale Field Logs

Contents:

1. 2013 Field Log

Snow Site Eval

5/10/2013
1 of 1

Tudor Site

ARR 1:13 pm SRW

TDR_OF — Samp:

WMS#1 NTU - 1.43 — Cl 1323

eC - μS 533 — TSS 1322

T - 44.5

V. est Q - √ small ~5gpm

~150' E of OF; no surface flow west of sample pt — infiltrate

TDR_WR1 — Samp:

NTU - 18.7 — Cl 1339

eC - 3012 — TSS 1338

T - 42.1

V. est Q - 50 gpm

Spruce Site

SRR_WR2 — Samp/Time

NTU - 9.8 — Cl 1405

eC - 518 — TSS 1404

T - 39.6

Vest Q - 35 gpm — plugged drain pipe w/ cap

Flow to wetland over RX diffuser

5/13/2013
1 of 2

All Red annotation by SRW 6/27/2013

Tudor Site

ARR 1:18 pm SRW

TDR_OF: no surf. flow from pond to stream outfall. No fugitive flows along entrance rd.

TDR_WR1 — Samp Time - 1335 — Cl — TSS

NTU - 29.7

eC - μS 2865

T - °F 41.7

Vest. Q - 50 gpm

pH - 7.46

TDR_WR3

NTU - 60.1

eC - 1630

T - 42.7

pH - 7.53

Vest Q - 50gpm

Samp Time - 1359 — Cl — TSS

pond outburst down W channel (Photo). Scour pluck moved ~2 cyds to weir throat + cleaned pond. Deposit now being scoured by MW flow.

5/15/2013
2 of 2

SPRUCE Site
arr 2:30pm

SPR_WR1

			Samp
			Time - 1439
	NTU	- 12.8	Cl
	eC	- 385	TSS
	pH	7.35	
	T	43.3	drain pipe capped
V. est	Q	Ø	Ø discharge @ New Rock flow diffuser w/ below overflow (evap)

water @ entrance culvert @ N to S flow · v. low (≈ 5gpm)

Site Eval
SRW

5/16/2013
1 of 2

Tudor Site arr 1305

No overland flow from outlet pipe to receiving water. No observable flow to receiving water. All meltwater Q @ site signif. down.

TDR_WR1

			Samp
			Time 1317
①	NTU	7.31	Cl⁻
②	eC	2507	TSS
	pH	7.61	
	T	35.5	
V. est	Q	35 gpm	

Snow Site Eval 5/16/2013
SRW 2 of 2

Spruce Site arr 1355

SPR_WR2 Samp Time 1358
NTU 8.10 Cl⁻
eC 442 TSS
pH 7.59
T 40.2
V est Q 20gpm

SPR_WR1 Samp Time 1408
NTU 9.88 Cl⁻
eC 436 TSS
pH 7.65
T 40.1
Q — about @ same level as 5/13; plug still in place. No observed seepage @ weir but flow distribution pool full + overflowing.

Snow Site Eval 5/28/2013
SRW 1 of 2

Tasker Site arr 1:35 Pm

TDR-PND1 Samp Time 1340
NTU 62.7 Cl⁻
eC 223 TSS
pH 8.63
T 56.5
Q Na

TDR_WR1 Samp Time 1356
NTU 20.4 Cl⁻
eC 962 TSS
pH 7.80
T 42.4
V.est Q 30 gpm

Shallow N end thinning rapidly + receding laterally. No flow below DPond outlet.

Snow Site Eval. 5/23/2013
SRW 2 of 2

TDR_DPND1 Samp Time 1413
NTU 22.6 Cl
eC 710 TSS
pH 7.86
T 49.5
Q —

Ⅴ in DPnd ~ 1" below T-inlet cap

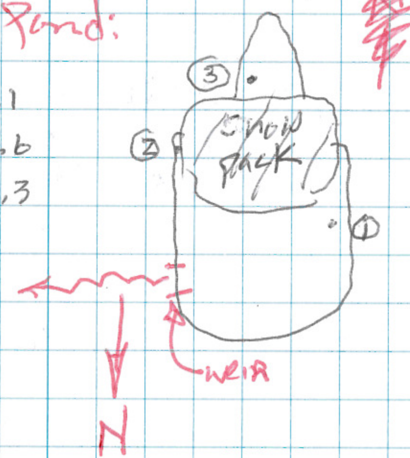
SPR_WR2 Samp Time 1435
NTU 6.66 Cl TSS
eC 348 (334) }
pH 9.21 (9.57) } SPR_WR1
T 51.8 (51.7) }
v. est. Q 20 gpm
no weir flow - underflow only - observed @ N weir post.

Snow Site Eval 5/28/2013
SRW/KLB 1 of 1
11:30 am

SPR_WR2 No sample
NTU 10.4
eC 214
pH 9.70
T 45.5
Q 30 gpm

Detention Pond:

Pt.	
1	10.1
2	7.6
3	7.3



Snow Site Eval. 5/30/2013
SRW arr 1201 1 of 2

Tudor Site

TDR_Stream

	NTU	1.63
	eC	589
	pH	6.99
	T	48.7
V. est	Q	2cfs

Samp
Time 1209
No Q @ Pond outlet pipe or along ditch.
Cl⁻
TSS

TDR_WR1

	NTU	82.2
	eC	229
	pH	7.37
	T	50.6
V. est	Q	40gpm

Samp 12:31
melt from park all along E lateral. head diff + ice thickness developed appears to be forcing discharge laterally just downslope of snow fill diff. ∇ in Pond just over cap on T inlet

Snow Site Eval 5/30/2013
SRW arr 1303 2 of 2
Spruce Site

Pond-side

SPR_WR1

NTU	13.1
eC	174
pH	9.64
T	60.5
Q	—

Samp
Time 1308
∇ Pond ~4" below V notch. Obvious weir seepage.
Cl⁻ TSS

outlet-side

SPR_WR2

	NTU	12.0
	eC	173
	pH	9.59
	T	54.7
V. est	Q	30gpm

Samp
Time 1316
Cl⁻
TSS

Sno Site Eval 6/6/2013
SRW 1 of 2

Tudor Site arr 1232

TDR_WR1 Samp ✓ Time 1257

	NTU	239 ✓	Cl⁻ TSS
	eC	137	Flows visibly
	pH	7.67	Turbid @ weirs.
	T	52.7	Abundant snow pack
V. est	Q	40 gpm	@ N end continue w/ hi pack @ S end

lead to flows along lateral rills; much mudflow into troughs + water exit onto surface of troughs ⇒ v. turbid.

Sno Site Eval 6/6/2013
SRW 2 of 2
Spruce Site arr 1320

SPR_WR2 Samp ✓ Time 1327

	NTU	13.2 ✓	Cl⁻ TSS
			Field Sample SPR_WR1 1338 ✓
	eC	98	
	pH	8.68	(Pond pH 9.20) Q = Ø
	T	55.6	No flow over
v. vol.	Q	35	weir. pond el. ~ 0.5' below peak el

SPR_~~WR1~~ Wet Ø

NTU	—	Field Sample ✓
eC	106	wetland @ 1350
pH	6.21	pt Ø (see 6/13)
T	60.5	~~Wlnd Ø~~
Q	—	SPR_~~Wlnd~~ Wet Ø

Snow Site Eval — 6/13/2013
SRW — 1 of 2

Tudor Site — arr 1235

Samp ✓

TDR_WR1 — Time 1251

NTU	330 ✓	Cl
eC	227	TSS
pH	7.57	
T	49.4	
Vest Q	~35 gpm	

No flow @ pond outlet pipe or along ditch. T, Small flow (~1 gpm) last 20' to stream. Stream flow up.

Q @ west weir ~ 100 gpm. N end pile + "wings" deteriorating. Ridged placement creating magnified NTU. Undulation (transverse) in basal ice apparent diverting flows laterally. Thin snow fill @ sides increasing laterally flows + mod flow.

Snow Site Eval — 6/13/2013
SRW — 2 of 2

Spruce Site — arr 1317

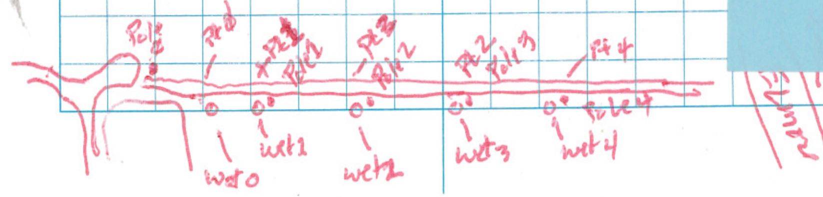
Samp ✓

SPR_WR2 — Time 1325

NTU	22.3 ✓	Cl
eC	69	TSS
pH	9.18	
T	52.7	
1, est Q	50 gpm	

wet1	pt 1 ✓		5.80		75		63.3	1342
wet0	pt 0. ✓	pH	6.31	eC	70	T	54.1	1339
wet3	pt 2. ✓		5.99		59		64.9	1357
wet2	pt 3 ✓		5.91		103		63.4	1350
wet4	pt 4 ✓		5.88		89		62.7	1405

1st pour pt	1	1st T pole
~~2nd pour pt.~~	2	3rd T pole
2nd pour pt	3	2nd T pole
E. end ponding	4	4th T pole
outlet	0	100' E of ø T pole
		50' E of distrib. weir



Sno Site Eval 6/20/2013
SRW 1 of 3
Tundra Site arrive 11:30A

		Samp
TDR-WR1		1155
NTU	511	Cl⁻
eC	244	TSS
pH	7.67	
T	64.7	
V. est Q	600gpm	

Blow out thru rock @ E channel, large flow enuff to move 1" gvl below E weir. N low sno pack completely melted. S high stack sno pack flowing laterally + across sed from low stack snow. Ridges & some micro splay features suggest larg sed not moved large distances @ uniform rate - pulse movement?

No flow @ D Pond outlet or along ditch.

Sno Site Eval 6/20/2013
SRW 2 of 3
Spruce Site arr: 1220

		Samp
SPR-WR2		1227
NTU	19.5	Cl⁻
eC	56	TSS
pH	7.39	
T	60.9	
V est Q	25gpm	

		Samp
SPR-WR1		1238
~~NTU~~		Cl⁻
NTU	24.5	TSS
eC	40	
pH	7.97	
T	67.90	
Q	—	

Sno mass gone. D Pond level ~ 9.25" ~~[illegible]~~ below V notch. Signif drop in pond pH. Opened pond drain @ end of all sampling/field testing

Sno Site Eval 6/20/2013
SPEW 3 of 3

Spruce site

			pH	ec	T	Q	
wet 0	pt 0 ✓		6.37	54	66.0	—	12[illegible]
wet 1	1		5.85	69	71.5	trickle	[illegible]50
wet 3	2		5.83	89	72.8	—	1259
wet 2	3		5.89	103	72.1	seepage	1254
wet 4	4		5.79	87	71.5	—	1303

4th T pole: surface water reduced.
V. brown water (?)

Sno Site Eval 6/27/2013
1 of

Tudor Site arr 12:40

TDR_STRM Samp 1250

	NTU	4.02	Cl TSS
	eC	229	no flow in outlet
	pH	7.28	ditch (bottom
	T	48.1	exposed + drying)
Vest	Q	1.5 cfs	no discharge to stream (Samp)

TDR_WR1 Samp 1304

	NTU	476	Cl TSS
	eC	144	
	pH	7.68	
	T	63.4	
Vest	Q	40	

Sno Site Eval 6/27/2013

Spruce Site arr

SPR-WR2 Samp 1330

	NTU	8.33	Cl
	eC	65	NTU
	pH	7.58	
	T	70.6	
Vest	Q	< 5 gpm (trickle)	

(no flow @ drain down pipe) ~ 0.5' el. diff pond surf. to distrib. weir pool

		Pt	pH	eC	T	Q
1335	wet 0 ✓	0	6.40	97	72.4	
1340	wet 1 ✓	1	5.54	~~Flow~~ 54	72.0	~~small seep across Rd~~
1349	wet 3 ✓	2	5.56	73	71.7	—
1346	wet 2 ✓	3	5.50	~~...~~ 74	68.5	—
—	wet 4	4	no sig. surf. ponding; surf. wet			

SPR_DPND1 1402 Samp

pH 8.79 pH

Qro Site Eval 6/28/2013
smn/ks p1 of 1

Spruce Site arr 10:50a

Located @ inlet gate culvert

SPR_wet5 FI - 11:32am

NTU	–	
eC	475	✓
pH	7.76	✓
T	59.4	✓
Q	Ø	

Snow Site Eval. 7/5/2023
Plot Snow

Tudor Site 7:24am arr.

TDR_WR1 Samp Ø752

	NTU	80.5
	eC	199
	pH	7.87
	T	45.0
Vert.	Q	25gpm

Ditch dry @ Drand outlet, Sno pile reduced to high ridge stack @ mid-site. Note width (E-W) not significantly reduced but height signif. lowered. Note prominent crowning between 2 outside V swales. Little or no central V apparent results in divergent surface w/snowmelt non-aggregated to V channels. Outlet may heighten NTU @ ice layer breakup + @ perimeter discharge.

Snow Site Eval. 7/5/2023
Snow p 2 of

Spruce Site arr.: 0820

		SPR_WR1	Samp 0824	
	NTU	5.06	4.67	SPR_WR2 no flow or seepage visible
Samp	eC	67	72	
Samp	pH	7.62	7.36	
	T	55.0	55.1	
Vert.	Q	Ø	Ø	

		Pt	pH	eC	T		Q
wet	Ø	0	6.41	81	52.7	8:28	Ø
"	1	1	5.77	61	54.4	8:30	seepage only (no surf flow)
8:37	3	2	5.58	70	54.3	~~8:34~~	seepag extends to ½ between 2+3
8:34	2	3	5.64	63	53.9	~~8:37~~	minor seepage only
	4	4	—	—	—		no seepage from 3 →

wetland surf ponding absent, wet surface no standing water

Tudor 3:15pm

TDR-WR1

NTU	82.8
uS Cond	155
pH	7.72
T	76.8
Q	25gpm

Ditch dry

Spruce

SPR-WR1

Ponded Water - no flow at weir

NTU	17.1
cond	85
pH	7.37
T	84.5

Point	pH	uS Cond	T	
0	5.80	60	72.2	
1	5.72	63	74.2	
2	5.21	70	69.9	squeezed
3	5.24	61	67.7	squeezed
4	—			

QC / calibration pH

blank 1	5.53	Tudor
2	5.61	Spruce
3	5.31	end
QC std 7	7.15	end

Sno Dispo[s]al Site Eval

7/19/2013
Sorw 1 of 2

Tudor Site arr 9:30 Am

TDR_WR1

	NTU	266	Efat 0942
	eC	239	
	pH	6.56	No Lab Samp
	T	55.2	
vert	Q	15gpm	

No flow @ DPond outlet ditch. Ditch bottom dry.

SnoDisposal Site Eval

7/19/2013
Srw 2 of 2

SBrace Site arr 1007

DPond + Distribution weir dry. no seepage or ponding @ Wetland edge.

V. Shallow ponding widely scattered @ all wetland Sampling points. No Surface overflow or ponding on Rd. only Pole P w/wet rd surface/minor seepage

max DPond depth just below V notch. (~ 3.5' max pond depth)

no samps / no field tests