Memorandum

Memo To:	Joe Coffey & Harry Ermides	**Date:**	November 6, 2015
From:	Brad Grant	**File:**	967.002.001
Re:	Technical Memo 3 Task 4: Proposed Mitigation Alternatives		

1.0 Introduction

In this third and final technical memo, B&L presents a list of mitigation strategies to manage and mitigate observed deficiencies at Buckingham Pond. Strategies, which were within the categories presented herein, were vetted at a project team meeting on March 20, 2015 where representatives from the City of Albany as well as the Buckingham Pond Conservancy were in attendance. This list presents only those alternatives for which there was support from all parties, and, for each, includes a brief description, general cost estimate (2015 dollars), and other elements to consider for each alternative (permitting, aesthetics, etc). It does not include conceptual design, technical specifications, or construction details. A general map illustrating the location(s) of each structural mitigation alternative is included as Attachment 1. Deficiencies addressed herein were documented in Technical Memo 1 dated November 5, 2014 and Technical Memo 2 dated November 5, 2015.

The conclusions of hydrologic modeling regarding high pond levels reported in Technical Memo 2 and overflow scenarios during extreme rain events were re-evaluated and are addressed in a revised memo issued November 5. Peak flow rates and overflow conditions were overstated in the original modeling and revisions made resulting in lower runoff values for volume and peak flow rates which reduced incidences of overflow in the structure at the east end of the pond. The general consensus is that the pond pump station and pond overflow system works and especially well when lowering of ponds levels via pumps are used before significant storms actually arrive but are known to be coming. The City actively pumps levels down for significant events when they are predictable.

2.0 Proposed Mitigation Alternatives

All proposed mitigation alternatives are depicted on the figure in Attachment 1.

2.1 Natural Resource Protection

- *Landscape Plan*
  - Description: A master landscape plan will clearly define the appropriate areas to implement the landscape-oriented mitigation alternatives

proposed herein. These shall include bioengineered shoreline stabilization practices, native buffers, path paver units, and turf-reinforcement mats. Additionally, the plan will select suitable native species to be installed on the site.

- Rationale: The plan, with schematic diagrams, will allow for a strategic and comprehensive approach to addressing water quality issues associated with shoreline erosion and on site plant matter.

- Cost: A master landscaping schematic plan with lists of recommended plantings would be approximately $6,000 in cost.

- Factors to Consider:

  - Invasive and non-native species should be avoided in any future landscaping. Such species can have negative effects on aquatic habitat and water quality.

  - Trees should be sited carefully so as to not introduce further leaf matter and other organics to the pond.

  - Consider establishing a mutually beneficial relationship with a nursery or landscape service to lower purchase costs via partnership and possible acknowledgement of firms' participation.

- *Bioengineered Shoreline Stabilization*

  - Description: Bioengineered shoreline stabilization is the use of plants to stabilize a shoreline. Plants with deep roots, and known ability to help prevent erosion are utilized along the banks and within the buffer.

  - Rationale: Timber cribbing installed by the City to prevent further shoreline erosion is in disrepair in many areas, and there is evidence of bank erosion along the pond. A bioengineered shoreline stabilization project would serve to improve water quality by eliminating sedimentation due to shoreline erosion, enhance habitats and aesthetics, enable nutrient uptake, and provide areas and structural support for buffer establishment. It will likely be most effective in areas where timber cribbing is in poor condition or where shoreline erosion is evident. Stabilization practices could also be used in areas where the buffer may be widened outward from the existing shoreline. This mitigation alternative is proposed at known areas of shoreline erosion as well as those areas that are currently stable and vegetated, including bench and lawn areas, but require preventative measures to avoid future erosion. These areas shall be clearly

defined in the master landscape plan. This would maintain some public access to the shoreline as opposed to a buffer around the entire pond that would limit access and unnecessarily replace existing stable vegetation at an increased cost. As the program to install shoreline and buffer amendments develops, the scope can be altered as future budgets and needs allow.

- Cost: Assumed installation of biodegradable/bioengineered shoreline protection and buffer along approx. 650 linear feet of shoreline at select areas while leaving stable vegetated/turf areas undisturbed to maintain access to water's edge, at an average 8 ft. width.

Task	Cost Estimate
• Design & Regulatory Coordination	$6,000
• Materials (per available rates)	
○ Structural (coir logs, mattresses, stakes, etc)	$11,000
○ Planting materials (live stakes, seed, seedling trees, etc.)	$11,000
○ Labor (installation assumed to be paid labor force opposed to volunteers)	$26,000

- Factors to Consider:

  - There are no required permits anticipated at the state or federal level that would potentially increase costs significantly and regulatory coordination would be required and is assumed to be relatively minor in the engineering effort to submit work plan and obtain need a water quality certification from NYSDEC.

  - Much of the labor can be performed by volunteers, which could drastically reduce the overall cost and should be given strong consideration. Procuring one or two professionals to provide guidance and oversight to volunteers would serve to be more cost-effective than hiring a labor crew/contractor and is assumed for most plantings except for installation of larger trees. In the interest of the cost estimate reflecting potential implementation without volunteer assistance it was assumed a paid labor force would install the bioengineered shoreline plantings.

- *Native Buffer Establishment*

  - Description: A buffer is a strip or area of native vegetation designed to mitigate the impacts of adjacent development and activities. In this case, the buffer is considered a riparian buffer because of its proximity to a water body. Buffers are typically a minimum of 25 feet wide to provide water quality benefits. Wider buffers provide additional benefits to wildlife. Ensuring selected plants provide a variety of fruits, nuts, and nectar suitable for the appropriate native wildlife will help to create a complete buffer ecosystem.

  - Rationale: Native buffers improve water quality, aesthetics, and habitat. Buffers should be comprised of native species and can be augmented with dormant cuttings taken from stock plants already on site. Existing signage around the Pond advises against mowing of the existing buffer and expanding both the breadth (width) and the extent of the buffer would maximize the benefits of this effort. Native plants require less maintenance than their non-native counterparts, and are intended to thrive in local conditions making them less costly to maintain in the long term and more effective at preventing erosion. Improving upon the existing vegetative buffer will provide an optimal habitat for native wildlife (where adequate width is available), aid in preventing erosion, and provide nutrient uptake from, and encourage infiltration of, runoff.

  - Cost: Costs for this alternative are integral with the bioengineered shoreline stabilization costs as the two strategies work best when implemented together. It is assumed, given site constraints, that there will be an average buffer width of 8 feet with some exceptions in areas where access directly to the pond is required as well as where additional width is available. These areas shall be clearly defined in the master landscape plan.

  - Factors to Consider: To save money, volunteer efforts may be utilized in this (see bioengineered shoreline stabilization).

- *Invasive Species Survey & Removal*

  - Description: Invasive species are non-native species that can cause harm to the environment or to human health and come from all around the world. They pose problems to our ecosystems; our food supply, including not only agriculture but also harvested wildlife, fish and shellfish; our built environments, including landscaping, infrastructure, industry, gardens, and pets. Invasive species have implications, too, for recreation and for human

health. Japanese knotweed, a known invasive to the Buckingham Pond Watershed, spreads rapidly, forming dense thickets that crowd and shade out native vegetation. This reduces species diversity, alters natural ecosystems, and negatively impacts wildlife habitat. The ground under knotweed thickets tends to have very little other growth, leaving the soil susceptible to erosion. Invasive plant inventories/surveys can provide fundamental information used for assessing and prioritizing invasive plant management efforts.

- Rationale: A variety of invasive vegetative species were observed in multiple locations around the site, including common buckthorn (Rhamnus cathartica), Japanese knotweed (Fallopia japonica), purple loosestrife (Lythrum salicaria), multiflora rose (Rosa multiflora), and common reed (Phragmites australis). Throughout the existing buffer, several species of non-native invasive plants were observed, in particular Japanese knotweed. Invasive species survey and removal improves habitats and aesthetics by removing risk of colonization and competition with beneficial native plants. A critical target species should be Japanese knotweed, which appears to be in early stages of establishment around the southern side of the Pond.

- Cost:

Task	Cost Estimate
• Species Inventory & Removal Plan	$8,000
• Annual Removal Costs (5 to 6 years of monitoring and maintenance expected)	$5,000/yr
• Native Plant Installation	Included in Bioengineered Shoreline Stabilization

Note: Annual removal cost is based on an average cost of $5/SF for pulling vegetation, disposal, and minor restoration per NYSDOT unit cost database. The yearly effort assuming a 10' removal width and a $5,000 budget would be a length of approximately 100'. If done every year this would total $30,000 and deemed appropriate for a pre-Species Inventory and Removal Plan estimate of cost. If large areas are identified in concentrated areas a less expensive option is to address when mechanically dredged if that is able to be done within a few years.

- Factors to Consider:

  - Actual cost for removal could vary greatly depending on type, density of actual species and trip distance to disposal area. It is

assumed a logical and approvable location can be found within 10 miles of the site.

- Many invasive species plans require multiple treatments, yet are volunteer-friendly with minimal professional oversight required at the front end consisting of plant identification and removal instruction, often by pulling or cutting by hand tools. Costs above assume substantial labor accomplished through paid labor force and not utilizing volunteer labor. If volunteers are available then savings could be realized but are not assumed herein.

- If herbicide treatments are to be used ('Rodeo', which is a glyphosate product like Round-up specified for use in proximity to aquatic environments), permitting will be required, but the cost associated is nominal.

- Initial removal should be performed in concert with planting native vegetation. This is one of the most effective ways of reducing the risk of re-colonization by invasives. Both removal of invasives and installation of the bioengineered materials may cause disturbance to soils that will create favorable conditions for invasives to become established, so minimal disturbance is recommended.

- The optimal time to effectively remove invasives and reduce risk of "grow-back" is in the latter parts of the summer, when much of the plant's food reserves are held in the vigorous parts of the plant above ground and not in its roots. This is true because removing the upper portion of the plant limits its ability to survive the trauma. Additionally, late summer/early fall is a good time to plant new vegetation. If timed properly, weather conditions will be hospitable for establishment, and there will be ample time for vegetation to become well-rooted before winter dormancy sets in.

2.2 Structural Projects

- *Rock Inlet/Outlet Protection*

  - Description: A heavy stone apron placed at the outlet end of a pipe or channel to reduce depth, velocity, and energy of water to prevent erosion.

  - Rationale: Construct or enhance existing outlet protection at location of pond inlets to reduce erosion during high flow storm events.

- Cost: Approximately $15,000 to excavate and construct all four inlet protection areas. 36 SY of treatment area are shown on the plan.

- Factors to Consider: Rip-rap outlet protection may be in place at varying levels at the three outlets in the stilling basin and should be supplemented. This measure should be performed while the pond is drained, or lowered to ease construction and minimize disturbance. The rock protection would be below normal water levels and virtually unseen and have no impact on the water quality or ecology of the pond except to greatly reduce the stirring of sediments from the velocity of the incoming runoff at pipe inlets and reduce turbidity as compared to the present condition. This type of rock is commonly used to stabilize waterways and pipe discharge areas. Re-sedimentation over the rock after installation would be reduced via the sediment capture of hydrodynamic separators on the incoming pipes.

- *Additional Pond Fountain*

  - Description: A spray fountain the same as the existing three fountain with electrical service locating slightly west of the parking lot and towards the channel section of the pond.

  - Rationale: To create some aeration, water movement and disrupt the surface layer of organic accumulations on the water surface and increase light and dissolved oxygen to improve water quality. This would also be aesthetically and acoustically pleasing and in keeping with existing aeration system.

  - Cost: Approximately $25,000 to provide electrical service and equipment. Engineering is not assumed to be required as City has installed these with their staff in the past, and assumed to be accomplished by the City.

  - Factors to Consider: The channel section of the pond would benefit with the addition of aeration and water circulation where no such capability exists now. This is the area of the pond often seen from the park.

- *Hydrodynamic Separators*

  - Description: A stormwater management practice that uses vortex-type separation to encourage the settling of solids and other pollutants. Regularly scheduled cleaning of the unit is required, and includes vacuuming sediment from a port located on the unit. It is proposed that units are considered for each subcatchment (i.e. each inlet into the stilling basin). Because local observations report the pond to be functioning adequately under the influence of existing flow rates, it is also proposed

that the units be sized to accommodate the existing pipe sizes for each inlet as well as the flow rate so as not to modify this condition. For reference, units from Contech have been specified herein for use and future comparison. Subcatchment 1 and 2, with a total peak flow rate of less than 15 CFS, can both be conveyed to one 10-foot diameter Contech CDS unit 14 feet deep. Subcatchment 3, with a peak inflow of 25 CFS, can be collected in one Vortechs 16000. Subcatchment 4 requires two Vortechs 16000 units to process the peak inflow of 36 CFS. In addition to requiring 2 units, the inflow must be divided which requires installation of a flow splitter manhole upgradient of the two units. The Vortechs 16000 unit is 12 feet wide and 18 feet long, requiring a larger available footprint.

- Rationale: These units will reduce sediment from entering the stilling basin through the inlet pipes and will provide easier points for sediment removal than the stilling basin and pond bottom.

- Cost (includes units with final design, permitting, installation, and permitting):

  - Subcatchment 1 & 2: $120,000
  - Subcatchment 3: $130,000
  - Subcatchment 4: $250,000

- Factors to Consider:

  - The exact location must take into account maintenance. Additional piping may be required to enable siting the units in a convenient location and allow for appropriate pipe routing. Maintenance will include regular vacuuming of each unit and other scheduled needs per manufacturer's recommendations.

  - Addressing Subcatchment 4, the largest and most built-out of the subcatchments, may offer the most relief to sedimentation and nutrient delivery to the stilling basin.

  - Routine maintenance of catch basins via vacuuming out sediments in their sumps is assumed to take place. Even with significant attention to catch basins there will be inflow of runoff with sediments, suspended in the water and non-suspended that will be conveyed to the separator units between catch basin cleaning operations which typically only captures the larger, heavier particles at best.

- Permits may be required by the Army Corps of Engineers if these devices will be permanently placed in a jurisdictional Waters of the U.S. below the ordinary high water mark.

- Depending on available space and final siting, property acquisition may be required. (See cut sheets in attachments)

- *Sediment & Woody Debris Removal*

  - Description: Dredging is the removal of sediments and debris from the bottom and sides of a water body below its normal water level. It becomes necessary due to sedimentation, which is the deposition of sand, silt, organic matter from vegetation/trees and other fines from upstream sources including localized erosion. In the case of Buckingham Pond, the water body can be near fully drained to provide a base for the excavator to traverse during dredging activities. Woody debris removal proposed is generally along shoreline between park/parking lot and stilling basin in the channel section of the pond. Although woody debris can be environmentally beneficial in streams and flowing channels for habitat the removals proposed consist of removal of only a dozen medium to large trunks that are rotting and add organic load to the water. This is mostly easily done during dredging operation and assumed that way for cost estimate.

  - Rationale: Sediment reduces available storage as well as efficacy of sediment & nutrient removal. While reducing the amount of sediment entering the pond system will improve the future condition, removal of existing sediment will serve to enhance the current effectiveness of the system.

  - Cost: Assuming mechanical removal (includes mobilization/de-mobilization, removal of dredged material and woody debris, final grading and restoration of sediments at disposal site. Dredging quantity estimated is approximately 6,700 CY of dredged sediments assuming in-place volume at pond. Estimates of costs are based on ability to dispose of dredged material within 10 miles of the pond and minimal to no land purchase or use costs for utilizing the disposal area. Assumed unit cost to dredge the material is $20/CY and hauling/disposal/offsite restoration unit cost is $35/CY. Approximately $35,000 is assumed for contractor's mobilization/de-mobilization at both sites. Approximately $15,000 is assumed for pond area/pavement restoration due to hauling/equipment trips and assumes modest treatment/natural dewatering of dredged material in stockpiles/windrows for a brief time before hauling in lined

trucks to limit offsite tracking. Engineering plans, permitting process and needed engineering costs are assumed to be $30,000. This results in a total estimated cost of $450,000 which includes the woody debris removals.

- Factors to Consider:
  - The need for dredging is apparent and one of the practices that will benefit water quality in the pond the most once implemented.
  - The pond is listed as wetland in National Wetland Viewer, and will require permits (State and/or Federal).
  - It can be challenging to secure public funding and grants for dredging but worth pursuing both public and private sources.
  - It is conceivable that there could be soils dredged that, when drained, could be considered topsoil and of value. For the purposes of the cost estimate, it was assumed the material dredged would have no market value and disposed of in a new fill area away from environmentally sensitive areas.
  - Due to the significant cost, it would be understandable to dredge the stilling basin in a first phase and address the pond when more funding becomes available.

2.4 Green Infrastructure Projects

- *Parking Lot Reconfiguration*
  - Description: This alternative includes the redesign of the parking lot to create a more environmentally friendly alternative to improve the quality of localized urban runoff into Buckingham Pond. The buffer in this location is narrow due to adjacent use; however, other measures can be implemented in this location to mitigate the effects of localized runoff and pollutants. Because significant tree cover exists in the location of the parking lot, it may be advisable for the western half of the parking lot to be retrofitted with porous pavement with an underdrain system.
  - Rationale: It became evident through field observations that significant sediment and leaf litter deposition into the pond takes place near the boat access area near the park. In an effort to improve water quality entering the pond, and because there is only a very narrow riparian buffer in this location, this measure is being presented.

- Cost: Earthwork, pavement, striping, curbing/underdrain, engineering, construction oversight, etc (assuming traditional pavement) is estimated to be approximately $250,000 without stormwater treatments costs discussed under bioretention and landscaping and $310,000 including them. The preliminary design assumption is that two bio-retention areas and two tree pits (each with one tree) would be utilized for stormwater quality treatment.

- Factors to Consider: Consideration may be given to maintaining a conventional parking lot and implementing tree pits or bioretention/rain garden areas in lieu of porous pavement. Ensure the feasibility of regular maintenance of porous pavement prior to design and installation if the decision is made to choose porous pavement.

- *Parking Lot Bioretention Area & Landscaping*

  - Description: Bioretention is a stormwater management practice intended to manage and treat stormwater runoff from impervious surfaces through use of specific subsoils and plants. These areas are shallow and depressed to collect runoff. The water ponds for 1 to 2 days and promotes filtering and infiltration. Bioretention systems include an underdrain and overflow device connected to a nearby storm sewer or appropriate reuse system. Plants can include shrubs, grasses, flowers, and other native plants and they can be designed to suit a variety of footprints and aesthetic desires.

  - Rationale: Bioretention may be beneficial upgradient from areas of the pond with an inadequate riparian buffer, or simply to act as a pre-treatment where space permits.

  - Cost: Typical documented costs are between $7/sf and $17/sf, although they can as high as $40/sf for more complex systems requiring the importation of soil media as well as other cost-inducing factors. NYSDEC data and design examples from their website were utilized and referenced for these unit costs. Other references from other states confirmed similar range of unit costs. Using New York State Department of Environmental Conservation design standards, approximately 10,000 sf of impervious area can be treated in a bioretention system of approximately 1,000 sf. Therefore, it can be assumed that a rough cost of $17,000 is associated with every 10,000 sf of impervious area treated in a bio-retention area. This is the equivalent of treating approximately 300 linear feet of a city street, or 5 homes with a roof area of 2,000 sf (excluding driveways). Volunteer labor, City in-kind services, and plant donations or subsidies can significantly reduce this cost but are not assumed for the cost estimate.

Consultant design costs for each bioretention area (two assumed), including a landscaping plan, will be approximately $5,000 or $10,000 total. Bioretention facilities conceptually evaluated for the parking lot enhancements are estimated to be approximately $30,000. A total of two tree pits are proposed for the reconfigured parking lot. Stormwater management for the reconfigured parking lot is estimated to be $50,000 if done by a contractor. Consideration was given to porous pavement but applications are generally more expensive and require significant and careful maintenance requiring special equipment that is also very expensive. Bioretention facilities incorporating vegetation were considered a more aesthetic practice as well as more cost effective for this site. Total costs for bioretention facilities and tree pits are approximately $60,000.

- Factors to Consider: Given local soils, this may not be feasible immediately adjacent to the pond. Significant runoff has been documented along Euclid Avenue as a result of the July 9, 2014 precipitation event, and this area may be a priority project area.

- *Path paver units and Turf-Reinforcement Mat (TRM)*

  - Description: Additional path paver units, similar to the ones used at the southeast end of the pond, are recommended for specific areas of high pedestrian traffic and to stabilize areas noted as eroded. Turf-reinforcement mat (TRM) product is recommended to reinforce eroded areas of turf or vegetation with a reinforcement mat to stabilize existing vegetation such as grass to better resist sheet and concentrated stormwater runoff. These treatment areas include near the parks fountain, path areas at park, at pedestrian crossing near Lenox Avenue, near concrete bench, southeast end of pond near Euclid Avenue, north of stilling basin and at path between stilling basin and pond.

  - Rationale: Paver units allow some infiltration of runoff and a stable walking surface to resist higher velocity flow that has affected specific areas around the pond's path. TRM products reinforce the shallow depth of earth in the root zone to also resist erosive velocities. Both products and strategies address stabilization at the area of erosion and intended to greatly reduce eroded soil materials from being conveyed to the pond.

  - Cost: Typical documented costs for quality paver units with gravel sub-base are between $15/sf and $50/sf, although they can as high as $75/sf for more complex systems requiring very deep gravel media as well as other cost-inducing factors. Using a unit cost of $20/SF to best represent the

estimated unit cost for the existing economy pavers used in the park, and 68 SY (612 SF) the paver costs would be approximately $12,300. TRM costs differ from type to type but generally are around $15 per square yard installed. Using a unit cost of $15/SY and 37 SY the paver costs would be approximately $1,000. An engineering plan to address these improvements is estimated to be around $2,000. Total costs are approximately $15,300.

- Factors to Consider: The pavers and TRM products could be an earlier action item if desired. The modest costs involved, the ability for volunteers to assist, and the immediate stabilization in eroded areas could influence the timing for these tasks.

- *Selective Watershed Enhancements*

  - Description: This alternative includes installation of homeowner and retrofit friendly green infrastructure/low impact development measures throughout the contributing watershed. These measures can include tree pits, porous pavement, rain gardens, rooftop disconnections, and rain barrels. Additionally, these enhancements are scalable depending on funding and other factors. Implementation of these practices will likely require many years to see broad acceptance and use by homeowners. The public education aspect and low initial costs for some of these practices, most notably the disconnection of rooftop drains, are two factors to embrace in order to implement those practices where stakeholders may achieve the greatest "bang for the buck" and may be achievable early in the project.

  - Rationale: Green infrastructure is used as a means of slowing down or infiltrating contributing stormwater, as well as treating runoff and, in some instances, reducing the urban heat island effect.

  - General practice Costs:

    - Tree Pits: While documented costs vary, it can be assumed that one Filterra Tree Pit unit, sized to treat ½ acre of impervious area, costs approximately $10,000.

    - Porous Pavement: Approximately $9/sf, and provides savings in winter sand/salt applications.

    - Rain Gardens: Simple rain gardens cost between $3 and $5 per square foot (1000 sf of impervious area can be treated in a garden of approximately 100 sf in size)

- Rooftop disconnections: Splash pads for disconnected gutters generally cost between $5 and $20.

- Rain Barrels: Costs vary from $50 for subsidized rain barrels through local programs to $300 for designer rain barrels.

▪ Factors to Consider:

- Public education is a critical part of "buy-in" from homeowners to enable significant implementation of these private property practices. As stated, rooftop disconnection is likely the most straightforward practice to implement quickly and yield advantageous impacts to Buckingham Pond.

- Tree pits may be utilized in watersheds that are not treated by other means such as a hydrodynamic separator, or may be utilized within the same watershed as a means of pre-treatment. An added benefit of tree pits is the provision of rainfall interception, shade, and lowering the effect of urban heat island effect depending upon the size of the tree planted.

- Porous pavement should be considered when repaving or full depth reconstruction of roadways is planned, and should be presented to homeowners as an alternative to conventional driveway materials.

- Rain gardens have gained popularity as an aesthetically pleasing, do-it-yourself project for homeowners to take part in improving urban water quality. Resources on properly sizing and siting a residential rain garden for the intended level of treatment should be available to residents, as well as guidance on determining whether a rain garden is feasible for site soils. Consideration may be given to Buckingham Pond Conservancy hosting training for members.

- Rooftop disconnections: Residents may not be aware that this option exists as a way to filter rooftop pollutants from rooftop runoff. A community education and outreach effort may help in bridging the knowledge gap. This measure can also be used in concert with a rain garden or rain barrel, or can be part of a complete solution including all three alternatives.

- Rain barrels: Assisting residents in understanding the volume of stormwater created by the roof catchment area is critical to ensuring proper sizing and implementation of this measure. For

example, an empty 50 gallon barrel can take 1" of rainfall from an impervious area of approximately 80 sf. Therefore, multiple barrels in series or an adequate overflow plan must be considered accordingly. Additionally, a use plan must be in place for the collected stormwater for this measure to have the intended benefits. Rooftop downspouts can be directed into the top of a rain barrel using a downspout diverter kit.

- These watershed green infrastructure enhancements may be implemented as other neighborhood improvements take place. They are scalable in nature depending on funding and other factors.

2.5 Community Pollution Prevention

- *Environmentally Friendly Landscaping Service*
  - Description: Procure a local organic landscaper specializing in native plants and low-impact practices for neighborhood landscaping. This can be accomplished by utilizing a NYSDEC "Be Green" landscaper. "Be Green" businesses sign an agreement with DEC for the right to use the "Be Green" service mark (logo). In return, they agree that, when they provide "Be Green" services, they will avoid the synthetic pesticides and other materials prohibited by the organic conditions as they are defined in the agreement. These landscaping businesses also take an introductory "Be Green" training course that outlines the conditions of the "Be Green" agreement and introduces the basic concepts of organic lawn care.
  - Rationale: Reducing use of pesticides and encouraging prevention over treatment as well as native landscaping serves to improve the health of the local ecosystem and reduce exposure of harmful or unnecessary chemicals and nutrients to people, animals, and receiving water bodies. Limiting the amount of land-applied nutrients only to what is necessary within the Buckingham Pond Watershed should aid in reducing the harmful effects of these nutrients within the pond by reducing the level delivered via overland sheet flow.
  - Cost: The scope of utilization of an environmentally friendly landscaping service is difficult to determine as the assumption is that homeowners would employ these types of gardeners and green practices to limit chemicals, pesticides, and non-organic fertilizers. The costs for this would be borne by individual homeowners as they determine needs for those services. We recommend having a gardener of this type attend a

community meeting that includes BPC to outline benefits of organic approaches, costs and rationale/benefits to encourage people to adopt an organic approach to their property. It is estimated that the cost of the alternative is approximately $15,000.

- Factors to Consider: Consider whether landscapers will offer a discounted neighborhood rate and inquire as to what other training has been provided to their employees to ensure best management practices. Additionally, it is not necessary that a "Be Green" landscaper be procured so long as organic, native and mechanical practices are a cornerstone of whichever service is obtained.

2.6 Management

- *Precipitation Event Preparation*

  - Description: Continue to pump stormwater from the pond from the pump station west of the stilling basin prior to anticipated significant storm events.

  - Rationale: This serves to lower the level of water in the pond system prior to significant precipitation events to ensure sufficient storage.

  - Cost: City services – NA.

  - Factors to Consider: NA

2.7 Community Outreach

- *Continued Public Engagement – Additional Signage and Public Education Series*

  - Description: This measure includes providing signage, in high visibility locations around the pond, pertaining to waterfowl feeding and other public environmental notices. It also includes educating residents on fertilizer usage and residential vehicle washing through mailers, posting on the Buckingham Pond Conservancy website, or sponsoring lecture series on topics of environmental relevance to the pond neighborhood and surrounding communities.

  - Rationale: This measure is intended to reduce pollutant contributors within the watershed and to educate and mobilize local residents to participate in practices that promote a healthy pond ecosystem.

- Cost: Assume upfront costs of up to $8,000 for various signage around the pond. Consideration of more natural signage than metal signage is assumed in these costs and could employ boulders with inset metal signage affixed to them to reduce visual impacts to view of the pond and utilize materials that are more natural. Assume annual cost of $1,000 to send mailers for each season (including ink, paper, and stamps) and 2 lectures per year to educate residents. Partner with Capital Roots, PRISM, Cornell Cooperative Extension, Soil & Water Conservation District, Albany County Stormwater Coalition, and others to provide public education opportunities. Public education costs are extended over 6 years. Total cost is estimated to be $14,000.

- Factors to Consider: This can be performed throughout the life of the pond, and should coincide with relevant pond projects to further engage the local community and strengthen fund raising efforts as needed. The public education aspect of this project

3.0 Proposed Phasing Plan

The mitigation alternatives suggested above are recommended to take place over multiple phases. Phases were determined based upon similar tasks required for each alternative as well as a reasonable order in which alternatives should be performed to ensure maximum benefit. Phases are as follows:

The following items should be noted in relation to the phasing plan:

- Phases 2, 3, and 4 may be performed during Phase 1 so long as establishing the native buffer is the final activity so as to minimize disturbance to the buffer for construction activities.
- Phase 3 can be put on hold and performed at a later date.
- Signage installation should be performed after buffers and related plantings have been established, yet can occur at any time afterwards.
- Public outreach and education of project activities have already begun and should continue throughout the life of the pond.

4.0 Cost Estimate

A summarized cost estimate for all proposed mitigation alternatives is presented in Attachment 2. This table relates the cost information contained in the body of this memo as well as the proposed phasing plan.

It should be noted that in addition to the design costs incorporated in each alternative, there is an engineering cost associated with the project as a whole. The individual design costs are offered to cover costs if the alternative practices are implemented in small phases or through self-help (i.e. not going through a public bid process). This cost quantifies the compilation of individual designs into a comprehensive and holistic plan as well as the production of construction documents and specification, construction administration, and construction inspection.

5.0 Next Steps

This memo will help form the basis of future prioritization, selection, and design of mitigation measures. Next steps should include the following:

- Presentation of the mitigation plan and report memo to stakeholders;
- Achieve a consensus of proposed approach before seeking potential grant opportunities;
- Identify public and private funding resources;
- Establish partnerships to implement projects listed herein.

The City of Albany has applied for public funding through the Consolidated Funding Application (CFA) for the NYSDEC Water Quality Improvement Program (WQIP) and the NYSEFC Green Innovation Grant Program (GIGP). In addition to these two programs, other applicable public funding avenues can and should be explored as well as private fundraising.

BDG/ojf
Attachment 1: Mitigation Alternative Map
Attachment 2: Mitigation Alternative Cost Estimate
Attachment 3: Cut Sheets

Attachment 1

Mitigation Alternative Map

MITIGATION STRATEGIES

BUCKINGHAM POND LAKE ASSESSMENT

CITY OF ALBANY

ALBANY COUNTY, NEW YORK

Barton & Loguidice, D.P.C.

Date
SEPTEMBER 2015

Scale
AS SHOWN

Figure Number
1

Project Number
967.002.001

Plotted: Nov 04, 2015 – 3:38PM By: rbw
Z:\BL-Vault\D2\18217AD2-1C71-4823-8927-99D5C4054147\0\796000-796999\796962\L\L\967.002.001 Mitigation Alternatives (ID 796962).dwg

Attachment 2

Mitigation Alternative Cost Estimate

Mitigation Alternative Cost Estimate

Sect.	Mitigation Alternative	Estimated Cost	Phase	Phase Cost Breakdown					Total
				1	2	3	4	Ongoing	
2.1	**Natural Resource Protection**								
	Landscape Plan	$ 6,000	1	$ 6,000	-	-	-	-	$ 6,000
	Bioengineered Shoreline Stabilization	$ 54,000	4	-	-	-	$ 54,000	-	$ 54,000
	Native Buffer Establishment	N/A	4	-	-	-	N/A	-	$ -
	Invasive Species Survey & Removal (Over 6 Years)	$ 38,000	Ongoing	-	-	-	-	$ 38,000	$ 38,000
2.2	**Structural Projects**								
	Rock Inlet/Outlet Protection	$ 15,000	1	$ 15,000	-	-	-	-	$ 15,000
	Additional Pond Fountain	$ 25,000	1	$ 25,000	-	-	-	-	$ 25,000
	Hydrodynamic Separators: Subcatchment 1 & 2	$ 120,000	1	$ 120,000	-	-	-	-	$ 120,000
	Hydrodynamic Separators: Subcatchment 3	$ 130,000	1	$ 130,000	-	-	-	-	$ 130,000
	Hydrodynamic Separators: Subcatchment 4	$ 250,000	1	$ 250,000	-	-	-	-	$ 250,000
	Sediment & Woody Debris Removal	$ 450,000	2	-	$ 450,000	-	-	-	$ 450,000
2.3	**Green Infrastructure Projects**								
	Parking Lot Reconfiguration	$ 250,000	3	-	-	$ 250,000	-	-	$ 250,000
	Parking Lot Bioretention Area & Landscaping	$ 60,000	3	-	-	$ 60,000	-	-	$ 60,000
	Path Paver Units & Turf-Reinforcement Mat	$ 15,300	1	$ 15,300	-	-	-	-	$ 15,300
	Selective Watershed Enhancements (Scalable)	$ 20,000	Ongoing	-	-	-	-	$ 20,000	$ 20,000
2.4	**Community Pollution Prevention**								
	Environmentally Friendly Landscaping Service	$ 15,000	Ongoing	-	-	-	-	$ 15,000	$ 15,000
2.5	**Management**								
	Precipitation Event Preparation	N/A	Ongoing	-	-	-	-	N/A	$ -
2.6	**Community Outreach**								
	Additional Signage	$ 8,000	Ongoing	-	-	-	-	$ 8,000	$ 8,000
	Public Education Series (2 Lectures/Year Over 6 Years)	$ 6,000	Ongoing	-	-	-	-	$ 6,000	$ 6,000
Subtotal		**$ 1,462,300**		**$ 561,300**	**$ 450,000**	**$ 310,000**	**$ 54,000**	**$ 87,000**	**$ 1,462,300**
Engineering (15%)		$ 219,345	Ongoing	-	-	-	-	$ 219,345	$ 219,345
Contingency (15%)		$ 219,345	Ongoing	-	-	-	-	$ 219,345	$ 219,345
Total		**$ 1,900,990**	**N/A**	**$ 561,300**	**$ 450,000**	**$ 310,000**	**$ 54,000**	**$ 525,690**	**$ 1,900,990**

Attachment 3

Cut Sheets

SECTION **[_____]**

STORM WATER TREATMENT DEVICE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope

The Contractor shall furnish all labor, equipment and materials necessary to install the storm water treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.

B. Related Sections

Section 02240: Dewatering
Section 02260: Excavation Support and Protection
Section 02315: Excavation and Fill
Section 02340: Soil Stabilization

1.2 QUALITY ASSURANCES

A. Inspection

All components shall be subject to inspection by the engineer at the place of manufacture and/or installation. All components are subject to rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair where final acceptance of the component is contingent on the discretion of the Engineer.

B. Warranty

The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.

C. Manufacturer's Performance Certificate

The SWTD manufacturer shall submit to the Engineer of Record a "Manufacturer's Performance Certification" certifying that each SWTD is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research.

.

1.3 SUBMITTALS

A. Shop Drawings

The contractor shall prepare and submit shop drawings in accordance with Section **[_____]** of the contract documents. The shop drawings shall detail horizontal and vertical dimensioning, reinforcement and joint type and locations.

PART 2.0 – PRODUCTS

2.1 MATERIALS AND DESIGN

A. Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:

1. Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
2. Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
3. Cement shall be Type III Portland Cement conforming to ASTM C 150;
4. Aggregates shall conform to ASTM C 33;
5. Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185, or A 497.
6. Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
7. Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.

B. Internal Components and appurtenances shall conform to the following:

1. Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
2. Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
3. Fiberglass components shall conform to the National Bureau of Standards PS-15 and coated with an isophalic polyester gelcoat;
4. Access system(s) conform to the following:
    a. Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

2.2 PERFORMANCE

A. REMOVAL EFFICIENCIES

1. The SWTD shall be capable of achieving an 80 percent average annual reduction for a particle distribution having a mean particle size (d_{50}) of 125 microns

2. The SWTD shall be capable of capturing and retaining 100 percent of pollutants greater than or equal to 3/16 of an inch regardless of the pollutant's specific gravity (i.e.: floatable and neutrally buoyant materials) for flows up to the device's rated-treatment capacity. The SWTD shall be designed to retain all previously captured pollutants addressed by this subsection under all flow conditions.

3. The SWTD shall be capable of capturing and retaining total petroleum hydrocarbons. The SWTD shall be capable of achieving a removal efficiency of 92 and 78 percent when the device is operating at 25 and 50 percent of its rated-treatment capacity. These removal efficiencies shall be based on independent third-party research for influent oil concentrations representative of storm water runoff (20 ± 5 mg/L). The SWTD shall be greater than 99 percent effective in controlling dry-weather accidental oil spills.

B. HYDRAULIC CAPACITY

1. The SWTD shall provide a rated-treatment capacity in accordance with Table 1. At this rated-treatment capacity, the device shall be capable of achieving an 80 percent removal efficiency for a particle distribution having a mean particle size (d_{50}) of 125 microns. This removal efficiency shall be supported by independent third-party research.

2. The SWTD shall maintain the peak conveyance capacity of the drainage network as defined by the Engineer.

C. STORAGE CAPACITY

1. The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. The sump chamber shall be separate from the treatment processing portion(s) of the SWTD to minimize the probability of fine particle re-suspension. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 20 inches in diameter.

2. The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills.

The minimum storage capacity provided by the SWTD shall be in accordance with the volume listed in Table 1.

2.3 MANUFACTURER

The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer.

PART 3 – EXECUTION

3.1 HANDLING AND STORAGE

1. The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be born by the contractor.

3.2 INSTALLATION

1. The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.
2. The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.
3. The contractor shall removal all loose material and pooling water from the SWTD prior to the transfer of operational responsibility to the Owner.

CONTECH ENGINEERED SOLUTIONS

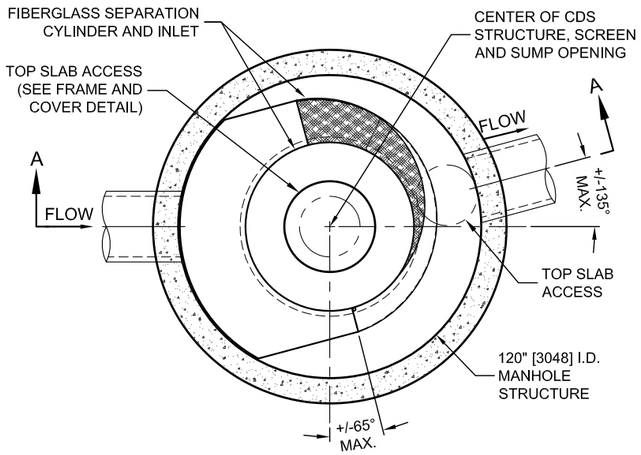
TABLE 1
Storm Water Treatment Device
Hydraulic and Storage Capacities

CDS Model	Treatment Capacity (cfs)/(L/s)	Minimum Sump Storage Capacity (yd^3)/ (m^3)	Minimum Oil Storage Capacity (gal)/(L)
CDS2015-4-C	0.7 (19.8)	0.9 (0.7)	61 (232)
CDS2015-5-C	0.7 (19.8)	1.5 (1.1)	83 (313)
CDS2020-C	1.1 (31.2)	1.5 (1.1)	99 (376)
CDS2025-C	1.6 (45.3)	1.5 (1.1)	116 (439)
CDS3020-C	2.0 (56.6)	2.1 (1.6)	184 (696)
CDS3025-C	2.4 (68.0)	2.1 (1.6)	210 (795)
CDS3030-C	3.0 (85.0)	2.1 (1.6)	236 (895)
CDS3035-C	3.8 (106.2)	2.1 (1.6)	263 (994)
CDS4030-C	4.5 (127.4)	5.6 (4.3)	426 (1612)
CDS4040-C	6.0 (169.9)	5.6 (4.3)	520 (1970)
CDS4045-C	7.5 (212.4)	5.6 (4.3)	568 (2149)
CDS5640-C	9.0 (254.9)	8.7 (6.7)	758 (2869)
CDS5653-C	14.0 (396.5)	8.7 (6.7)	965 (3652)
CDS5668-C	19.0 (538.1)	8.7 (6.7)	1172 (4435)
CDS5678-C	25.0 (708)	8.7 (6.7)	1309 (4956)
CDS2015-5-F	0.7 (19.8)	1.5 (1.1)	109 (413)
CDS2020-5-F	1.1 (31.2)	1.5 (1.1)	142 (538)
CDS2025-5-F	1.6 (45.3)	1.5 (1.1)	153 (579)
CDS3020-6-F	2.0 (56.6)	2.1 (1.6)	202 (765)
CDS3030-6-F	3.0 (85.0)	2.1 (1.6)	288 (1089)
CDS3035-6-F	3.8 (106.2)	2.1 (1.6)	327 (1236)
CDS4030-7-F	4.5 (127.4)	4.3 (3.3)	402 (1522)
CDS4040-7-F	6.0 (169.9)	4.3 (3.3)	500 (1892)
CDS4045-7-F	7.5 (212.4)	4.3 (3.3)	543 (2056)
CDS5640-8-F	9.0 (254.9)	5.6 (4.3)	554 (2098)
CDS5653-8-F	14.0 (396.5)	5.6 (4.3)	720 (2727)
CDS5668-8-F	19.0 (538.1)	5.6 (4.3)	859 (3252)
CDS5678-8-F	25.0 (708)	5.6 (4.3)	1081 (4091)
CDS3030-V	3.0 (85.0)	1.5 (1.1)	N/A
CDS5042-V	9.0 (254.9)	1.6 (1.2)	N/A
CDS5050-V	11.0 (311.5)	1.6 (1.2)	N/A
CDS7070-V	26.0 (736.3)	3.3 (2.5)	N/A
CDS10060-V	30.0 (849.6)	7.1 (5.4)	N/A
CDS10080-V	50.0 (1416.0)	7.1 (5.4)	N/A
CDS100100-V	64.0 (1812.5)	7.1 (5.4)	N/A

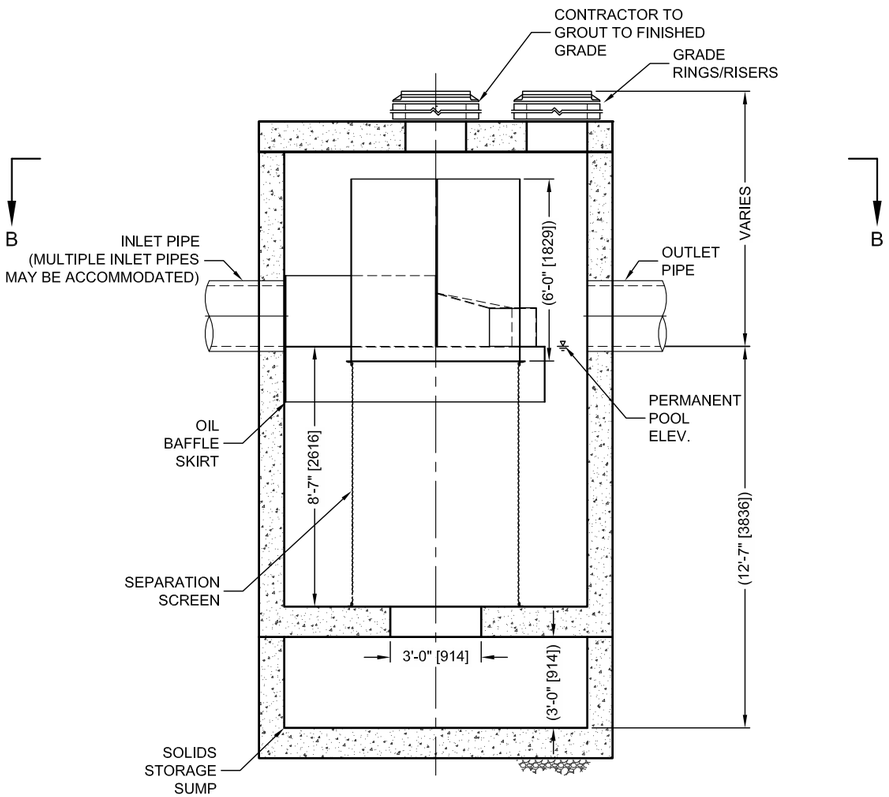
* Note that all “-C” systems can be fitted with a grated inlet if necessary

* Note that system internals for the “-C” and “-F” models can be put in larger manholes to accommodate site demands which may change standard capacities listed above

END OF SECTION



PLAN VIEW B-B
N.T.S.



ELEVATION A-A
N.T.S.

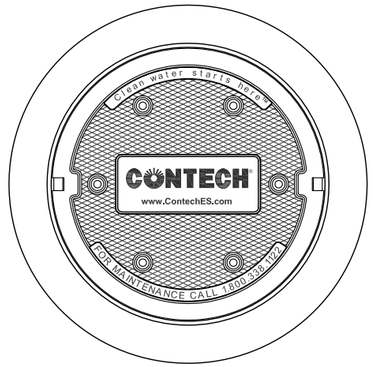
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,782; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CDS5678-10-C DESIGN NOTES

CDS5678-10-C RATED TREATMENT CAPACITY IS 25.0 CFS [708.0 L/s], OR PER LOCAL REGULATIONS. MAXIMUM HYDRAULIC INTERNAL BYPASS CAPACITY IS 50.0 CFS [1416 L/s]. IF THE SITE CONDITIONS EXCEED 50.0 CFS [1416 L/s], AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

THE STANDARD CDS5678-10-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES
SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION)
SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	
WATER QUALITY FLOW RATE (CFS OR L/s)	*
PEAK FLOW RATE (CFS OR L/s)	*
RETURN PERIOD OF PEAK FLOW (YRS)	*
SCREEN APERTURE (2400 OR 4700)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*

RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECHENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS5678-10-C
INLINE CDS
STANDARD DETAIL

SECTION [_____]

STORMWATER TREATMENT DEVICE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Work Included

The Contractor, and/or a manufacturer selected by the Contractor and approved by the Engineer, shall furnish all labor, materials, equipment and incidentals required and install all precast concrete stormwater treatment systems and appurtenances in accordance with the Drawings and these specifications.

1.2 QUALITY CONTROL INSPECTION

A. The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection by the Engineer. Such inspection may be made at the place of manufacture, or on the work site after delivery, or at both places, and the sections shall be subject to rejection at any time if material conditions fail to meet any of the specification requirements, even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the site shall be marked for identification and shall be removed from the site at once. All sections which have been damaged beyond repair during delivery will be rejected and, if already installed, shall be repaired to the Engineer's acceptance level, if permitted, or removed and replaced, entirely at the Contractor's expense.

B. All sections shall be inspected for general appearance, dimensions, soundness, etc. The surface shall be dense, close textured and free of blisters, cracks, roughness and exposure of reinforcement.

C. Imperfections may be repaired, subject to the acceptance of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final acceptance. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi (28 MPa) at the end of 7 days and 5,000 psi (34 MPa) at the end of 28 days when tested in 3 inch (76 mm) diameter by 6 inch (152 mm) long cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs.

1.3 SUBMITTALS

A. Shop Drawings

The Contractor shall be provided with dimensional drawings and, when specified, utilize these drawings as the basis for preparation of shop drawings showing details for construction, reinforcing, joints and any cast-in-place appurtenances. Shop drawings shall be annotated to indicate all materials to be used and all applicable standards for materials, required tests of materials and design assumptions for structural analysis. Shop drawings shall be prepared at a scale of not less than 3/16-inches per foot (1:75). Six (6) hard copies of said shop drawings shall be submitted to the Engineer for review and approval.

PART 2 – PRODUCTS

2.1 MATERIALS AND DESIGN

A. Concrete for precast stormwater treatment systems shall conform to ASTM C 857 and C 858 and meet the following additional requirements:

1. The wall thickness shall not be less than 6 inches (152 mm) or as shown on the dimensional drawings. In all cases the wall thickness shall be no less than the minimum thickness necessary to sustain HS20-44 (MS18) loading requirements as determined by a Licensed Professional Engineer.

2. Sections shall have tongue and groove or ship-lap joints with a butyl mastic sealant conforming to ASTM C 990.

3. Cement shall be Type II Portland cement conforming to ASTM C 150.

4. All sections shall be cured by an approved method. Sections shall not be shipped until the concrete has attained a compressive strength of 4,000 psi (28 MPa) or until 5 days after fabrication and/or repair, whichever is the longer.

5. Pipe openings shall be sized to accept pipes of the specified size(s) and material(s), and shall be sealed by the Contractor with a hydraulic cement conforming to ASTM C 595M

B. Internal aluminum plate components shall be aluminum alloy 5052-H32 in accordance with ASTM B 209.

C. Sealant to be utilized at the base of the swirl chamber shall be 60 durometer extruded nitrile butadiene rubber (Buna N) and shall be provided to the concrete precaster for installation.

D. Brick or masonry used to build the manhole frame to grade shall conform to ASTM C 32 or ASTM C 139 and shall be installed in conformance with all local requirements.

E. Casting for manhole frames and covers shall be in accordance with ASTM A48, CL.30B and AASHTO M105. The manhole frame and cover shall be equivalent to Campbell Foundry Pattern #1009A or #1012D custom cast with the Contech Engineered Solutions logo and the words “Vortechs® Stormwater Treatment System”.

F. A bitumen sealant in conformance with ASTM C 990 shall be utilized in the sealing of the joint between the swirl chamber and the vault at the long wall tangent points. The butyl material shall be 3/4-inch thick by 3/4-inch wide.

2.2 PERFORMANCE

A. Each stormwater treatment system shall adhere to the following performance specifications at the design treatment capacities, as listed below:

Table 2.2

Vortechs® Model	**Design Treatment Capacity** (cfs)/(l/s)	**Sediment Storage** (yd^3)/(m^3)
1000	**0 - 1.6 (0 - 45)**	**0.7 (0.54)**
2000	**1.6 - 2.8 (45-80)**	**1.2 (0.91)**
3000	**2.8 - 4.5 (80-125)**	**1.8 (1.38)**
4000	**4.5 - 6.0 (125-175)**	**2.4 (1.84)**
5000	**6.0 - 8.5 (175-240)**	**3.2 (2.45)**
7000	**8.5 - 11.0 (240-315)**	**4.0 (3.06)**
9000	**11.0 - 14.0 (315-400)**	**4.8 (3.67)**
11000	**14.0 - 17.5 (400-495)**	**5.6 (4.28)**
16000	**17.5 - 25.0 (495-710)**	**7.1 (5.43)**

Each stormwater treatment system shall include a circular aluminum “swirl chamber” (or “grit chamber”) with a tangential inlet to induce a swirling flow pattern that will accumulate and store settleable solids in a manner and a location that will prevent re-suspension of previously captured particulates.

Each stormwater treatment system shall be of a hydraulic design that includes flow controls designed and certified by a professional engineer using accepted principles of fluid mechanics that raise the water surface inside the tank to a pre-determined level in order to prevent the re- entrainment of trapped floating contaminants.

Each stormwater treatment system shall be capable of removing 80% of the net annual Total Suspended Solids (TSS) load based on a 50-micron particle size. Annual TSS removal efficiency models shall be based on documented removal efficiency performance from full scale laboratory tests. Annual TSS removal efficiency models shall only be considered valid if they are corroborated by independent third party field testing. Said field testing shall include influent and effluent composite samples from a minimum of ten storms at one location.

Individual stormwater treatment systems shall have the Design Treatment Capacity listed in Table 2.2, and shall not re- suspend trapped sediments or re-entrain floating contaminants at flow rates up to and including the specified Design Treatment Capacity.

Individual stormwater treatment systems shall have usable sediment storage capacity of not less than the corresponding volume listed in Table 2.2. The systems shall be designed such that the pump-out volume is less than ½ of the total system volume. The systems shall be designed to not allow surcharge of the upstream piping network during dry weather conditions.

A water-lock feature shall be incorporated into the design of the stormwater treatment system to prevent the introduction of trapped oil and floatable contaminants to the downstream piping during routine maintenance and to ensure that no oil escapes the system during the ensuing rain event. Direct access shall be provided to the sediment and floatable contaminant storage chambers to facilitate maintenance. There shall be no appurtenances or restrictions within these chambers.

Stormwater treatment systems shall be completely housed within one rectangular structure.

2.3 MANUFACTURER

A. Each stormwater treatment system shall be of a type that has been installed and used successfully for a minimum of 5 years. The manufacturer of said system shall have been regularly engaged in the engineering design and production of systems for the physical treatment of stormwater runoff during the aforementioned period.

Each stormwater treatment system is shall be a Vortechs® System protected under U.S. Patent #5,759,415 as manufactured by

Contech Engineered Solutions
9025 Centre Pointe Drive, Suite 400
West Chester, Ohio 45069
800-338-1122

PART 3 – EXECUTION

3.1 INSTALLATION

A. Each Stormwater Treatment System shall be constructed according to the sizes shown on the Drawings and as specified herein. Install at elevations and locations shown on the Drawings or as otherwise directed by the Engineer.

B. Place the precast base unit on a granular subbase of minimum thickness of six inches (152 mm) after compaction or of greater thickness and compaction if specified elsewhere. The granular subbase shall be checked for level prior to setting and the precast base section of the trap shall be checked for level at all

four corners after it is set. If the slope from any corner to any other corner exceeds 0.5% the base section shall be removed and the granular subbase material re-leveled.

C. Prior to setting subsequent sections place bitumen sealant in conformance with ASTM C 990 along the construction joint in the section that is already in place.

D. After setting the base and wall or riser sections, prepare to install the swirl chamber. Place the 3/4-inch (19 mm) thick by 3/4-inch (19 mm) wide butyl mastic seal vertically on the outside of the swirl chamber starting one inch above the bottom of the swirl chamber and continuing to a height equal to the elevation of the bottom of the upper aperture of the swirl chamber. The butyl mastic seal should abut the downstream side of the pre- drilled mounting holes that attach the swirl chamber to the long walls of the concrete vault. Next, install the extruded Buna N seal on the bottom edge of the 180 degree downstream section of the swirl chamber by first applying a bead of Sikaflex-1a polyurethane elastomeric sealant into the extruded slot then slide the seal onto the swirl chamber. The extruded seal should extend 3-inches (76 mm) upstream of the mounting holes, toward the inlet end of the vault. Set the swirl chamber into position and keep the seal approximately ½-inch (13 mm) above the floor of the concrete vault. Apply a continuous bead of Sikaflex-1a sealant under the cupped bottom of the seal. Set the circular swirl chamber on the floor of the vault and anchor it by bolting the swirl chamber to the side walls of the concrete vault at the three (3) tangent points and at the inlet tab using HILTI brand stainless steel drop-in wedge anchors or equivalent 3/8-inch (10 mm) diameter by 2-3/4 inch (70 mm) minimum length at heights of approximately three inches (3”) (76 mm) off the floor and at fifteen inch (15”) (381 mm) intervals to approximately the same height of the butyl mastic sealant (at locations of pre-drilled holes in aluminum components). Apply a continuous bead of Sikaflex-1a sealant to the intersection of the inside bottom edge of the extruded seal and the vault floor.

E. If the oil baffle wall (Baffle A) and flow control wall (Baffle B) are not integrally cast-in to riser/wall sections then the Baffle wall panels shall be placed in the formed keyways or between bolted-in-place angle flanges as provided by the manufacturer. Apply non-shrink grout or Sikaflex-1a sealant to each end of Baffle A and Baffle B at the upstream intersection with the side walls of the concrete vault.

F. Prior to setting the precast roof section, bitumen sealant equal to ASTM C 990 shall be placed along the top of the oil baffle wall (Baffle A), using more than one layer of mastic if necessary, to a thickness at least 1-inch (25 mm) greater than the nominal gap between the top of the baffle and the roof section. The nominal gap shall be determined either by field measurement or the shop drawings. Do not seal the top of Baffle B unless specified on the shop drawings to do so. After placement of the roof section has compressed the butyl mastic sealant in the gap over Baffle A, finish sealing the gap with an approved non-shrink grout on both sides of the gap using the butyl mastic as a backing material to which to apply the grout. If roof section is “clamshell” or “bathtub” halves, then finish sealing the ends of the Baffle walls by applying non- shrink

grout or Sikaflex-1a sealant to each end of Baffle A at the upstream intersection with the side walls of the concrete vault and to each end of Baffle B at the downstream intersection with the side walls of the concrete vault.

G. After setting the precast roof section of the stormwater treatment system, set precast concrete manhole riser sections, to the height required to bring the cast iron manhole covers to grade, so that the sections are vertical and in true alignment with a ¼-inch (6 mm) maximum tolerance allowed. Backfill in a careful manner, bringing the fill up in 6- inch (152 mm) lifts on all sides. If leaks appear, clean the inside joints and caulk with lead wool to the satisfaction of the Engineer. Precast sections shall be set in a manner that will result in a watertight joint. In all instances, installation of Stormwater Treatment Systems shall conform to ASTM specification C 891 “Standard Practice for Installation of Underground Precast Utility Structures”.

H. Holes made in the concrete sections for handling or other purposes shall be plugged with a nonshrink grout or by using grout in combination with concrete plugs.

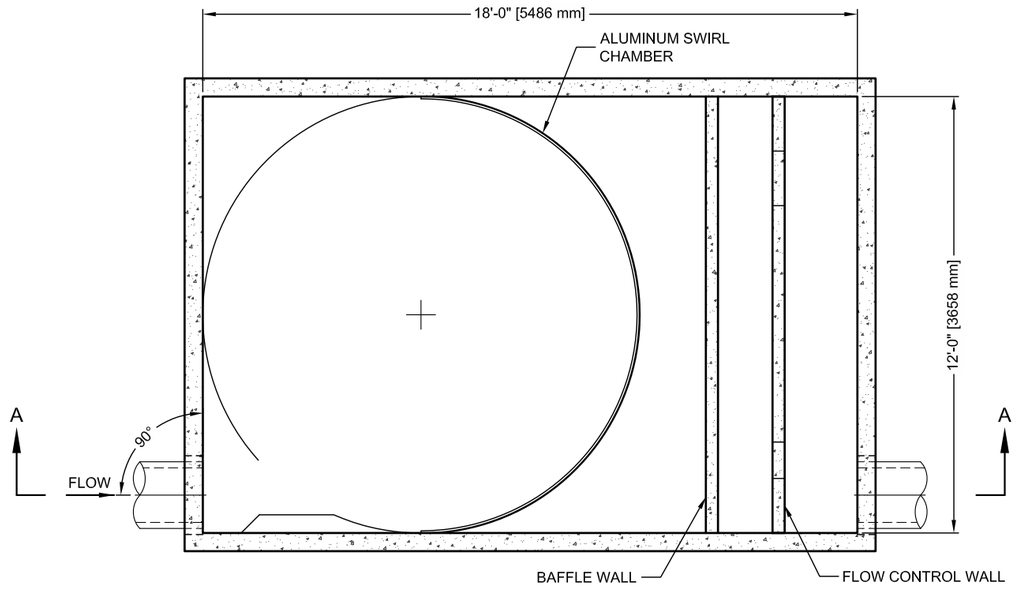
I. Where holes must be cut in the precast sections to accommodate pipes, do all cutting before setting the sections in place to prevent any subsequent jarring which may loosen the mortar joints. The Contractor shall make all pipe connections.

END OF SECTION

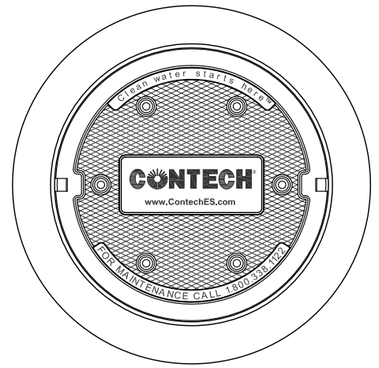
VORTECHS 16000 DESIGN NOTES

VORTECHS 16000 RATED TREATMENT CAPACITY IS 25 CFS, OR PER LOCAL REGULATIONS. IF THE SITE CONDITIONS EXCEED RATED TREATMENT CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

THE STANDARD INLET/OUTLET CONFIGURATION IS SHOWN. FOR OTHER CONFIGURATION OPTIONS , PLEASE CONTACT YOUR CONTECH CONSTRUCTION PRODUCTS REPRESENTATIVE. www.ContechES.com



SECTION B-B



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	*
WATER QUALITY FLOW RATE (CFS)	*
PEAK FLOW RATE (CFS)	*
RETURN PERIOD OF PEAK FLOW (YRS)	*

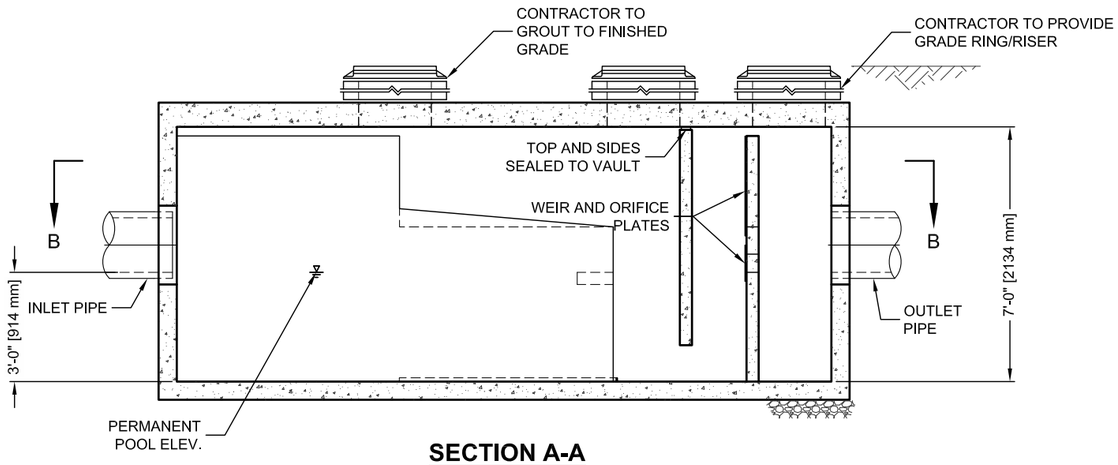
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*

RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD



SECTION A-A

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
4. VORTECHS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET AASHTO M306 LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. INLET PIPE(S) MUST BE PERPEDICULAR TO THE VAULT AND AT THE CORNER TO INTRODUCE THE FLOW TANGENTIALLY TO THE SWIRL CHAMBER. DUAL INLETS NOT TO HAVE OPPOSING TANGENTIAL FLOW DIRECTIONS.
7. OUTLET PIPE(S) MUST BE DOWN STREAM OF THE FLOW CONTROL BAFFLE AND MAY BE LOCATED ON THE SIDE OR END OF THE VAULT. THE FLOW CONTROL WALL MAY BE TURNED TO ACCOMODATE OUTLET PIPE KNOCKOUTS ON THE SIDE OF THE VAULT.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE VORTECHS STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

Vortechs®

CONTECH® ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

VORTECHS 16000
STANDARD DETAIL