Section II-3 Work Plan

WORK PLAN

The BMP Manual produced in this contract should be a true Design Manual. It should be capable of guiding the site designer through the initial process of evaluating the existing site conditions and examining the proposed land development concept plan for application of non-structural measures (geometry, layout, etc) and preservation of critical site features, such as vegetation and soils. Second, the application of specific measures in the stormwater system should follow a strict protocol documented in the manual. The structural measure selection process begins with a simple mandate – replicate the natural hydrologic system as much as possible, and infiltrate. Guidance should be provided as to the appropriate structural BMP for a given situation. Specific details for design, construction, and maintenance must be provided. And, most importantly, the analytical methods for the engineering calculations must be provided for both the designers and reviewers so that the important elements of water quality, infiltration, and rate control can be confirmed. The traditional software packages used for the design of detention basins have often stood in the way of the use of many BMPs, as neither the designer nor the review engineer is certain as to the correct analysis to confirm that the proposed BMP design meets regulatory requirements. Guidance for calculations and review must be provided in this Manual.

The Work Plan begins with a Scoping meeting between the team and DEP staff, followed by a Contract meeting to confirm that the desired Tasks are fully understood and agreed to between parties. The Team will then meet with the Oversight Committee to outline the Work Plan and modify it accordingly to their input. In many ways, they represent a "focus group" of future users of the Manual, and they must be convinced of the usability and wisdom of the end product. When this process has been complete, the Manual Format and Manual Outline (Table of Contents) will be developed, again in concert with the Department and Oversight Group.

The Data Compilation and Literature Search describes the internal and external information process by which the Team will summarize and document not only their own experience and design guidance, but will search their respective area of knowledge to be sure that all available information on each subject is gathered and considered. Most of this work will be performed by CA and GeoSyntec staff, with input by other team members.

The Development of Sections in the Manual will be divided by area of expertise and integrated by CA staff. CA staff will focus specifically on Infiltration BMPs and the Preparation of the "BMP Hydrology and Water Quality Worksheets". CA will draw upon the several hundred infiltration systems they have designed and built during the past twenty years to provide the documentation of effectiveness of measures, supplemented by other experience in the literature.

The following sections describe Chapters or sections of the Manual that we would propose as being essential for a true Stormwater Design Manual.

Site Analysis Issues Chapter

The Site Planning and Design Procedure begins with an understanding of the site. An inventory of the site natural features, as complete as possible, is essential in order to understand stormwater issues, both the constraints of the site as well as the opportunities which might be afforded by site soils and vegetation, for example. Background data files on hydrology, soils, and geology are generally available and are intended for use statewide. Information can be derived from the PAGIS system (PASDA) as part of the initial site evaluation process. The Manual will discuss how to use this information in evaluating the initial site conditions and selecting the appropriate nonstructural and structural measures for stormwater management.

Of course, additional information invariably will be required. Use of infiltration systems requires a variety of additional soil testing to be undertaken, as well as selection of the appropriate locations for infiltration. Good stormwater management requires that stormwater be part of the initial design and not an afterthought, and so this chapter will discuss that approach, as well as specific site information required and testing procedures.

Additionally, we would suggest that an awareness of the watershed, and the location of the project, should enter into the stormwater design process. Both designers and reviewers consider factors such as the stream classification (is it an EV watershed?), local flooding concerns, and drinking water sources. Stormwater management needs to consider the watershed, not just the project.

Building Program Issues Chapter

Clearly, a variety of important issues relate to determination of the Building Program. Obviously, as suggested by the Procedure, the Building Program is heavily influenced by the Applicant's (or owner or developer). At the same time, there are numerous "specifications" at least in those municipalities with comprehensive plans and zoning ordinances and subdivision/land development regulations which have bearing on what development can be done and how development is done at each site. From a total watershed system perspective, it is important to address these broader issues. Perhaps there is some flexibility in the planning and zoning regulations themselves? Is there any flexibility in the building program? What can be done in terms of modifying the building program (amount of development, type of development?)? What can't be done? Should these regulations be changed? Even with the optimizing of nonstructural and structural management, impacts cannot be totally eliminated. Watershed planning and analysis has indicated that zoned densities in the most sensitive watershed areas can be redirected to other less sensitive zones through transfer of development rights and other techniques.

Nonstructural Approaches Chapter

Use of Low Impact Development (LID) nonstructural techniques includes clustering, minimizing imperviousness, use of a minimum disturbance/maintenance site design approach, maximizing Time of Concentration (TC), maximizing disconnection, distribution, and decentralization of stormwater management systems. When taken together, these design elements will both minimize the generation of stormwater resulting from any particular proposed building program as well as provide maximum mitigation opportunity for stormwater generated to be applied. These design strategies such as Minimum Disturbance/Maintenance can be very effective in reducing use of chemicals, including fertilizers and pesticides and herbicides, which result in water quality problems. Communities across the country are instituting many of these land use-related requirements for water quantity and quality and other environmental reasons. Increasingly, jurisdictions are requiring that appropriate nonstructural approaches be utilized. The further good news is that application of so many of these nonstructural techniques also can generate a variety of other environmental benefits, such as improved habitat and overall aesthetics, and have been shown to translate into enhanced land values, lot-by-lot, as well.

As important as nonstructural approaches are, these approaches become more challenging to integrate into this Stormwater Management Manual because they extend into so many different aspects of a municipal plan and zoning ordinance. In years past, stormwater management regulations were pigeon-holed into a couple of paragraphs of a municipality's subdivision/land development regulations. At this point, stormwater management is reaching out and into virtually all aspects of the land development ordinance! That's exactly as it should be.

Clustering/Open Space Design/Conservation Design

A manual could be devoted just to clustering and conservation (aka open space subdivisions). Holding the building program (i.e., density) constant, but reducing lot size and concentrating or clustering lots allows much more of the site to remain undisturbed and serves to reduce imperviousness as the same time, all of which is critical for stormwater management. If the next critical step is taken and the clustering is allowed to "fit" into the areas of the site that Site Analysis (above) has indicated are free (or relatively free of environmental constraints), then optimal "Growing Greener" results may even be achieved. In any case, considerable research is on now hand to demonstrate that clustering techniques offer the potential of substantially reducing total disturbed area as well as total impervious area through reduced roadways lengths and reduced driveways.

Minimum Disturbance/Maintenance (Site Fingerprinting/Footprinting)

Minimum Disturbance/Minimum Maintenance (MD/M; EPA and other agencies have referred to this concept as site fingerprinting or site footprinting) is an approach to site design where the clearing of vegetation and the disturbance of soil are carefully limited to a prescribed distance from proposed structures and other improvements. MD/M is especially appropriate for those sites with existing tree cover, although the vegetation to be conserved may include any type of natural vegetative cover (e.g., dune grasses and other coastal vegetation, meadow, and so forth). Tree cover need not be restricted to mature hardwood forest; immature species (so-called scrub vegetation) provides very significant water quantity and quality benefits and the MD/M concept can be used at sites which have been cleared where re-vegetation and re-forestation is then proposed.

Benefits of MD/M relate both to the construction phase of development as well as to the long term operations of the site and its landscape. During construction, MD/M achieves a significant reduction in total site disturbance, thereby minimizing sedimentation and erosion control problems. Not only is a problem avoided by not creating disturbed areas which are prone to erosion, but maximum secured and vegetated areas are conserved, available to receive runoff (e.g., through use of level spreading devices) and mitigate the stormwater quantity and quality problems which cannot be avoided. After construction and during the long-term operation of the site, the same "double bang for the buck" benefits are enjoyed. Far less of the site has been disturbed and compacted, avoiding the increased curve numbers and increased runoff that inevitably follow. Secondly, retaining the natural vegetation and avoiding replacement with an artificial landscape of some sort also means reduction of significant loads of chemicals (nutrients, pesticides, herbicides), which typically accompany these artificial landscapes after the construction phase. Thirdly, as stated above, protection and conservation of expanded zones of natural vegetation provide an excellent cost effective opportunity for infiltration and comprehensive stormwater management for that runoff which cannot be avoided, obviously very close to the source or point of generation.

Minimize Impervious Area

The Center for Watershed Protection, the US Environmental Protection Agency, Prince George's County (Maryland), the Delaware Department of Natural Resources and Environmental Control, and other agencies have now developed significant guidance which defines an approach to site planning and design which has been termed Low Impact Development (LID), sometimes Conservation Design. The objective of LID is not to avoid development and not to alter the building program necessarily, but rather to accomplish the building program under the existing zoned densities in ways that reduce site impacts, especially impacts to stormwater quantity and quality.

Low Impact Development (LID) is an innovative stormwater management approach built on a basic principle that is modeled after nature: manage rainfall at the source using uniformly distributed decentralized micro-scale controls. LID's goal is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source. Techniques are based on the premise that stormwater management should not be seen as stormwater disposal. Instead of conveying and managing / treating stormwater in large, costly end-of-pipe facilities located at the bottom of drainage areas, LID addresses stormwater through small, cost-effective landscape features located at the lot level. By definition, LID tends to be highly decentralized with stormwater being managed as close to the source as possible, all of which are critical in carbonate rock contexts. These landscape features, known as Integrated Management Practices (IMPs), are the building blocks of LID. Almost all components of the urban environment have the potential to serve as an IMP. This includes not only open space, but also rooftops, streetscapes, parking lots, sidewalks, and medians. LID is a versatile approach that can be applied equally well to new development, urban retrofits, and redevelopment / revitalization projects.

Low Impact Development typically translates into reduction of imperviousness, although LID also includes conservation of natural features, hydraulic disconnection, disbursement of runoff, bioretention, grass swales and channels, rain barrels and cisterns, vegetated roof gardens, permeable pavements, and vegetated filter strips. A variety of specific strategies to reduce imperviousness are described in this section. In many cases, ways to reduce imperviousness relate to new approaches to planning, the so-called neo-traditionalism or new urbanism, as well as to clustering. In these cases, planning for new street systems is often based on a hierarchical system where the function and use of the particular roadway can be linked to width and other characteristics relating to imperviousness. These approaches in most cases can stand alone and be used development-by-development, although reduction in imperviousness also can be used in tandem with other approaches and practices. Reduction in imperviousness also is achieved through other LID/Conservation Design approaches, such as clustering.

A major variable in considering imperviousness is the consideration of transportation which includes roads, turnarounds, sidewalks, and other features:

Roads: In many developing areas, minimum street widths have been established which are excessive and which do not reflect functional needs now or in the future. Width reduction offers considerable potential benefit in terms of stormwater reduction. For the very smallest access street or lane with fewer than 100 vehicle trips per day (15 homes), decrease width to

16 feet. Increase width as the traffic increases (20 feet for 100-500 trips per day, 26 feet for 500-3,000 trips per day, and so forth). In conventional developments with conventional lots and house design, there is no need to provide on street parking, although if tightly clustered configurations are used, on street parking may be a desirable option and included in the design (add another 8-foot lane).

Turnarounds

Parking: Avoid inflated parking ratios. Additionally, sharing of parking areas by creative pairing of uses should be considered wherever possible. Municipalities should even provide positive incentives for developers to utilize sharing options. In terms of parking stall design standards, parking stall size can be reduced without compromising performance of the parking lot.

Driveways

Sidewalks

Reduction in imperviousness translates directly into stormwater quantities, both in terms of peaking and total runoff volumes. Although such provisions may not appear to be all that significant for one particular site or development, these reductions do become significant as they are totaled across entire municipalities or entire watersheds. In terms of water quality, benefits are not as directly related in that pollutant loadings are not just a function of paved area. Loadings are also a function of number of vehicle trips, comings and goings. Therefore, to the extent that a tightly clustered development may reduce vehicle miles traveled by, for the sake of example, 50 percent, but not have a significant effect on total number of trips, pollutant reduction will fall somewhere in between.

Parking lot costs are highly variable. Schueler (1995) cites a Maryland 1990 figure of $2.75 per sq. ft., which can be expected to have increased to $3 or more by 1996 (NIPC cites a construction cost of $16.50 per sq. yd. as of 1996, excluding curbs and gutters). Assuming that the rough estimate of 400 total paved area sq. ft. per parking space is reasonable, pavement costs alone come to $1,200 per parking space, excluding costs of land, stormwater management, etc. If parking area requirements can be reduced as discussed above, cost savings clearly are considerable. Road construction is more costly than parking lot construction, on a square foot basis and usually constitutes a major portion of the total site development budget. State transportation departments use $150 and $100 per linear foot as an estimate of current road cost, assuming full gutters and curbs, at 30 feet and 20-foot widths. Eliminating curbs and gutters would reduce road costs by about $15 per linear foot.

Consequently, the substantial reductions in road construction achievable through LID and Conservation Design techniques can have significant cost implications as well. Virtually all aspects of this approach translate into cost savings of one sort or another. Furthermore, all of these impervious surfaces must be maintained on an ongoing basis and even replaced over the longer run. Reduced street widths mean quicker deicing and less snow removal – reduction in paved area translates into cost savings.

Maximize Time of Concentration

Every effort should be made to maximize pathways in the stormwater routing process, extending routing through maximum use of naturally vegetated systems such as stormwater swales.

"Roughness" should be maximized through use of vegetation. Pathways themselves should be maximized to slow the routing process, rather than reduce the Time of Concentration, thereby worsening the stormwater management problem.

Maximize Distribution/Decentralization of Stormwater Management

Evaluate stormwater management opportunities as close to the point of generation as possible. Integrate stormwater management into the site plan itself. Integrate stormwater management into individual lot design through recharge or rain gardens and other techniques. As lot size increases, utilize available lot area for maximum infiltration. Yard areas can be gently terraced and used for subtle and broad infiltration "basins." Streetscapes in higher density areas can incorporate vegetated recharge systems that include sidewalks and essential infrastructure, accomplish stormwater functions, and are aesthetically pleasing as well.

Maximize Hydraulic Disconnection

Numerous opportunities exist, especially in residential subdivisions, for portions of site area to be disconnected from the main stream of stormwater-routed flows. Management in these cases can be quite micro in scope, possibly using subtle berms parallel to existing contours or subtle natural depressions or level spreading devices and other features. In many cases portions of roof areas may be distributed onto yard areas. Avoid direct piping whenever possible.

The Land Planning and Low Impact Development elements are intended to first describe and outline these concepts by a series of questions asked by the designer, and then to demonstrate the application of the concepts to real world examples. Since this process is somewhat less rigorous than the numeric analysis of runoff volumes and pollutant generation, the net benefits with each measure will be more difficult to quantify, but some tabular estimate of both volume reduction and quality improvement will be developed. This work has been developed by CA in several prior studies and will be expanded for this Manual, with specific suitability for PA communities and their Land Regulation guidance reflected in the Municipalities Planning Code and the typical Land Development Ordinance.

Structural Practices Chapter

There are many BMP Manuals and sources for specific structural BMP techniques, and all of the available information, as well as the detailed experience information from the Team's technical experts, will be gathered and integrated to present the most up-to-date information on structural BMPs that range from vegetated roofs and wetlands to infiltration systems. However, we believe there are some shortcomings to other BMP manuals that have prevented the best BMPs from being as widely used as possible, and we would strive to overcome these "road blocks" with this manual.

The first and probably most significant difficulty is that there is no one methodology or approach for calculating the effectiveness of a BMP for the three concerns of rate attenuation, volume reduction (or infiltration benefits), and water quality. Designers and reviewers who are familiar with the methods of designing and approving detention basins for peak rate control are not certain how to evaluate the effects of, for example, a Rain Garden on peak rate attenuation or infiltration. While porous pavement may seem like a good idea, the designer may or may not know how to design the infiltration bed so that it also provides peak rate attenuation. And even if the designer can develop an approach, there is no certainty that the municipal review engineer will agree or accept the calculations. The end result of this conflict is that the engineers often fall back to standard detention basins because the process is known and accepted and avoids any project delays. The other frequent occurrence is that the designer will have multiple BMPs – one for rate, one for infiltration, and one for water quality – without recognizing that a single BMP might achieve all three needs or knowing how to quantify the benefits. The result is a site that is "BMP'd out" – a complaint we have frequently heard from projects in Maryland where there has been uncertainty on the design engineer's part, so he or she puts in "one of everything", and maybe not in the most effective manner.

To overcome this difficulty, we would propose that the Manual include a chapter on stormwater calculations for infiltration, quality, volume, and peak rate, and that these calculations be provided in a "Worksheet" format based on the USDA Cover Complex Method and the similar to the worksheets found in TR-55, *Urban Hydrology for Small Watersheds*. These worksheets would be developed in a spreadsheet format and made available electronically with the BMP Manual. This approach is discussed in more detail later, and would be provided in a chapter of the Manual entitled "BMP Hydrology and Water Quality Worksheets". While this effort was not part of the RFP and has not been part of other BMP manuals, we believe it is critical to the adoption and implementation of BMPs by the engineering design and review community, and we believe it will be the only way for projects to demonstrate compliance with the DEP Model Ordinance requirements.

Another challenge is that many BMP manuals contain general design guidance, but do not provide sufficient detail on design or construction for the user to effectively incorporate the details into the project construction plans. Additionally, information on important construction procedures, materials, and maintenance is not always specific.

We would propose to bring the considerable design experience of the Team to this task to develop structural BMP information that provides this level of detail. The Team includes the considerable national experience of Cahill with regards to infiltration, vegetation, and retrofit situations, as well as the international experience of Roofscapes in the design and construction of vegetated roof systems. A.S. Greene Environmental provides hands-on experience regarding water quality wetlands and stream corridor restoration techniques. The Team includes more than researchers; it includes professionals recognized as leaders in their field who have been through the BMP design and construction process numerous times, and know how to "get it right".

Finally, earlier BMP manuals have provided a cookbook of ideas and BMPs, but little guidance on how to select and locate the proper BMP for a specific situation. This can be critical to full success of a BMP. For example, while Cahill is a strong advocate of porous asphalt, we would caution its use in an individual home situation where the next homeowner could easily "sealcoat" the porous asphalt. Similarly, vegetated systems requiring a certain level maintenance are more appropriate where there is a landscaping service or homeowner's association. We would propose that the Manual include specific recommendations regarding the most appropriate BMPs for different situations. This is not intended to limit designers, but rather to provide some direction as to what works best where.

We would also suggest that the BMP Manual, or a related DEP web page listing, identify BMPs that have been installed in Pennsylvania and are available for the public to visit. Growing Greener has funded numerous projects across Pennsylvania, and many of these projects are in locations where the public can have access to a particular BMP. This ability to inspect a BMP and get a “hands-on” experience will help further promote the implementation of BMPs.

With regards to the types of BMPs included, we would include all available structural BMPs for discussion, with a wide variety of options and designs for infiltration systems to support the requirements of the DEP Model Ordinance.

Many sites have some natural infiltration capacity, or ability to restore infiltration, and most projects proposed for development should be capable of incorporating infiltration. In many sites, however, the best portions of the site (those that have been in cultivation or are well-drained) are the areas proposed for land development. It is for this reason that the traditional detention basin design of the past twenty-five years was usually placed in the lowest, wettest portion of the site plan. With infiltration, the better locations on the parcel must be used for infiltration, which makes the initial site evaluation process even more important. Stormwater management can no longer be relegated to the unusable or undevelopable portions of the site, but must be fully integrated with the development program.

For those sites and situations where infiltration cannot be fully implemented in a reasonable fashion, and the question of reasonableness is somewhat discretionary, the water quality measures become even more important, and will probably rely on vegetative systems to provide sufficient pollutant removal from runoff.

In many aquatic environments and specifically in groundwater, the concentration of the solute Nitrate is a significant water quality pollutant of concern, and infiltration of stormwater does not significantly reduce this pollutant. Experience with a number of stormwater management measures indicates that vegetative systems such as wetlands are only capable of removing this pollutant if the biomass is harvested or removed from the measure, introducing a significant operation and management burden for the BMP. The BMPs that reduce or avoid land application of Nitrate as a fertilizer are by far the most efficient method of reducing the load generated by this pollutant in runoff, as compared to any treatment or removal BMP. In any case, the list of NPS chemicals should be expanded in the Manual and guidance provided as to the most appropriate measure, with specific reduction criteria required.

The most efficient Water Quality Measure is infiltration, if conditions and site program allow sufficient capacity. This conclusion depends on an adequate depth of soil mantle, with appropriate Cation Exchange Capacity (CEC>10 meq) and sufficient depth above both water table and bedrock (3 feet). Lacking the opportunity to treat all runoff generated from a development plan by infiltration, the set of other measures must be described and their relative efficiency documented. Several prior studies have provided much of this information, especially the types of measures than can be considered as “intervention or treatment units”. This includes all of the more recent products that are installed in the conveyance system, either as build structures (boxes, special inlets, etc.) or inserted into the stormwater plumbing to capture and contain pollutants, with subsequent removal.

The severe problem with many of the water quality BMPs developed is that they are inadequate for the combined impact of volume and pollutant capture/removal, and application usually requires multiple elements in the management system. The concept of a “treatment train” or series of measures configured in runoff flow pathway alignment, may have applicability in many site designs, especially where the stormwater management system is distributed throughout the development. This is especially true in residential sites, and so the explanation of how to apply these water quality measures will focus on this type of land development

The use of Wetlands as a BMP requires that we think of this vegetative system as a supplement to natural systems, and requires the appropriate topologic and hydrologic conditions for design. In those sites where existing conditions of high water table and poor drainage limit infiltration, the construction of wetlands can be a useful BMP for water quality, especially Suspended Solids and Phosphorus reduction, as well as metals and Total Petroleum Hydrocarbons (TPH). The ASGECI experts will research and document this specific area on interest so that the measure finds appropriate application and consideration in the Manual.

The Vegetated Roof section will expand on the current experience and operation of such systems in Europe and the recent experience in the US to prepare a general set of guidelines on the volume reduction and pollutant removal efficiency expected with different designs. As the leading US expert on these systems, Charlie Miller of Roofscapes will develop and document this measure and its suitability, as well as the anticipated efficiency, depending on the design variations. In effect, we can capture greater amounts of rainfall by increasing the storage capacity, and depending on what other measures are applied on the site, the need may be greater or less. If site conditions are limited or lost by the development plan, the roof can provide the final option for volume reduction.

Other BMP options, which have been part of the US Green Building Council program but have not been included in many BMP manuals, include techniques such as Capture and Reuse of stormwater for irrigation, landscape, or toilet flushing needs. Several methods of this type have been developed by CA, and other examples exist across the US that will provide both design guidance and specific examples.

Finally, the design experience with detention systems will be included and peak attention of rate summarized as a method. Prior manuals, including the original PADEP version, have focused on this system, and can be expanded to reflect any new developments in the measure. Specifically, those detention systems that have been or can be modified to include water quality mitigation, such as wet basins and multi-chamber systems will be described in detail and design guidance provided. While the simple detention basin will no longer be a sufficient stormwater management measure on its own, there may be situations where they will be required as part of a multi-part system that includes water quality and partial infiltration measures. More significantly, the retro-fitting of existing basins may be the only BMP option in some situation, and so Detention Basin Retrofitting will be addressed as a BMP.

The integration of these sections into a comprehensive and readable Manual will require a key role in the editing of the various technical sections, and W. Horner of CA will play this role of Editor, with the guidance of the Oversight Committee. His experience in this capacity is summarized in the following vitae and with project examples. Suffice to say that he is both rigorous and ruthless as a technical editor.

As the Manual evolves from written form to both a printed and electronic form, other staff will provide the skills for document production. Examples of prior work products can and will be offered to the Department as the final form of the Manual evolves, and the Department will have much to say with respect to this document design. In a sense, the basic issues will be resolved early in the process, so that the final assembly will be largely in a form ready for publication.

Stormwater Calculations – BMP Calculations and Water Quality Worksheets

As mentioned above, technical designers and reviewers are often limited by available calculation techniques and software for the design and implementation of BMPs, and there is no single approach that is broadly accepted for the evaluation of a BMP for peak rate attenuation, volume reduction (and infiltration) and water quality. Demonstrating compliance with municipal ordinances is often a challenge. Future designs will need to demonstrate compliance with the requirements of the DEP Model Ordinance.

CA has faced this challenge numerous times in the approval process of the many infiltration systems that we have built, and so we have developed a methodology using TR-55 Cover Complex Method to demonstrate peak rate attenuation as well as volume reduction. For other clients, we have further developed this methodology into a series of spreadsheet "Worksheets", modeled after the TR-55 worksheets, to help both the designer and reviewing engineer evaluate the hydrologic calculations and assure compliance with regulatory requirements.

We would propose that the Manual include "BMP Hydrology and Water Quality Worksheets", based on the USDA Cover Complex Method and available in electronic form for general use. These worksheets would be developed in a spreadsheet format and made available electronically with the BMP Manual. Again, while this effort was not part of the RFP, we believe an accepted methodology for calculations is critical to the adoption and implementation of BMPs by the engineering design and review community, and we believe it will be the only way for projects to demonstrate compliance with the DEP Model Ordinance requirements.

Prior research has demonstrated that infiltration of the net increase in volume during the 2-year frequency rainfall will effectively mitigate 95% of the annual rainfall, and will also mitigate the peak rate of runoff for the 100-year frequency event, the current standard in most jurisdictions. Most importantly, it will allow the construction of a single system for stormwater management and provide specific design criteria for that system. While this may not be appropriate to all cases and sites, the use of these Worksheets will allow the designer to avoid building separate BMPs for quality, rate, and infiltration, and make the best use out of the right BMPs for that site. The Task here is to produce a working tool for inclusion in the Manual to support the BMP designers needs.

Public Participation

The Cahill Team recognizes the great importance of the Public Participation Process in developing a comprehensive BMP Manual that successfully provides guidance to a variety of groups and organizations. Input from Pennsylvania agencies, organizations and the public is imperative in the development of a Manual that combines the very latest in stormwater management expertise with its practical implementation within the State.

As stated above, the Manual is a crucial step in a program of changing stormwater practices. Change rarely comes easily. It is of paramount importance that the process of developing this Manual take every opportunity to communicate both why new stormwater management approaches and practices are so essential as well as what these new approaches and practices involve. Meetings anticipated as part of the Public Participation Process are essential to maximize stakeholder support which is likely to be less than complete at the outset of the Manual preparation process.

Public Participation should be an ongoing process throughout the development of the manual. The Cahill Team will coordinate with the Oversight Committee to compile a comprehensive list of interest groups and organizations that should be invited to participate in the manual planning process. This group should meet periodically so that input is gathered during all stages of manual development. Furthermore, the general public will be informed and given opportunity to comment at appropriate intervals during manual development. All comments will be reviewed with the help of PADEP staff. A thorough comment and response document will be produced within the required time frame and comments will be incorporated in the final document where appropriate.

WORKSHEET 1 . LAND COVER AND CURVE NUMBERS

PROJECT: Rams Head Center

SUB-BASIN: Meeting of the Waters - 4

Existing Conditions: Land Use Types Within Drainage

Cover Type	Area	Area	CN	A * CN
Woodland				
Cleared W				
Planting B				
Meadow L				
Lawn				
Grass Pla				
Buildings				
Roads/Pa				
Pathways				
Water				
TOTAL:				

WEIGHTE

WORKSHEET 2 . CHANGE IN RUNOFF VOLUME FOR 2-YEAR STORM

Condition	Area (ac)	CN	S* (in)	I_a* (in)	Runoff Q* (in)	Runoff Volume (cf)
Before Dev						
After Dev						
Net Difference						

NET CHANGE IN
(REQ'D STORAG

WORKSHEET 3 . VOLUME REDUCTION MEASURES

Required Storage Volume (from Worksheet 2): 5675

Measure Type	Area	Storage Volume Provided per SF*	Net Storage Volume (cf)
			0000
			5000
			3600
			8600
			5675
			2925

WORKSHEET 4 . PEAK HYDROGRAPH MITIGATION

Unit Peak Hydrograph Values
For SCS TYPE II Rainfall Distribution

T_c = 0.1 hr

I_a/P	q_u (csm/in)	q_u
0.1	1010	3.6E-05
0.2	973	3.5E-05
0.3	936	3.4E-05
0.35	885	3.2E-05
0.4	806	2.9E-05

T_c = 0.15 hr

I_a/P	q_u (csm/in)	q_u
0.1	889	3.2E-05
0.2	841	3.0E-05
0.3	793	2.8E-05
0.35	735	2.6E-05
0.4	660	2.4E-05

Based on TR-55 Graphical Peak Discharge Tables and Formulas

Q_p (cfs)
17.2
19.3
4.7

WORKSHEET 5. VOLUME REDUCTIONS FOR PROJECT SPECIFIC MEASURES

Storage Element	Area (sf)	Ave. Depth (in)	Available Void Space	Total Storage Volume (cf)	Assumed Capacity	Storage Credit (cf)
Cistern	6000	16	90%	7200	50%	**3600**
Plaza Soil Matrix	20000	20	20%	6667	75%	**5000**
Infiltration Bed	50000	18	40%	30000	100%	**30000**
TOTAL						**38600**

WORK PLAN and LABOR DISTRIBUTION

The Level of Effort estimated to complete this contract is a total of 3,360 person-hours. Cahill Associates will perform the major portion of these services, with a total number of hours of 2,160 and a participation of 64%. The sub-contractor labor is distributed as follows:

GEOSYNTEC	384 hours	11%
Roofscapes	80 hours	2%
Amy Green	160 hours	5%
LIDC	216 hours	6%
PEC	360 hours	11%

PA BMP Manual
WORK SCHEDULE

Assumes start work order 5/1/03

WORK TASK	FY 1	FISCAL YEAR 2				FISCAL YEAR 3	
	5/1-6/30	7/1/2003			6/30/2004		
	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
	2003	2003	2003	2004	2004	2004	2004
Scoping Mtgs	■						
Contract Mtgs.	■						
DEP Oversight Comm. (6)	■	■	■	■	■		
Task Plan	■						
Status Report		■	■	■	■		
Problem ID Report		■	■	■	■		
Data Compilation		■					
Literature Research		■					
Manual Format	■						
Manual Outline	■						
Site Analysis							
Site Factors and Analysis		■	■	■			
Building Program Issues							
Twp. Zoning/SLDO		■	■	■			
Design Phase I- Preventative BMPs							
Minimum Disturbance/Maintenance		■	■				
LID, Imp. Coverage, Lot Config.			■	■			
Stormwater Analysis and Methodology		■	■	■			
Design Phase 2. Mitigative BMPs							
Infiltration measures		■	■	■	■		
Water Quality Measures		■	■	■	■		
Wetland Systems							
Vegetated Roof Systems		■	■				
Capture/reuse systems			■	■			
Detention systems		■	■				
Rain Gardens, Berms, Swales, etc			■	■			
Document Production							
Final Edit					■		
Graphic, tables, format					■		
Final Report (Gray scale, 24)					■		
Electronic (Quark, 24 CDs)					■		
Interest Group Mtgs (5)		■	■	■	■		
DEP Training Sessons (6)						■	■
Consultant Workshops (6)						■	■

PA BMP Manual
WORK PLAN and LABOR DISTRIBUTION

LABOR (Person-days)

	CAHILL ASSOCIATES					Roofscapes	GEOSYNTECH			ASGECI		PEC		LIDC		TOTAL	Mtgs.
	PE	PE	PP	SE	SS/SP	PE	PS	PE	Staff	PS	Staff	PP	Staff	NW	staff		
WORK TASK	Cahill	Adams	Horner	Potts-Wible	McDaniels-Marm	Miller	Roy	Stecker	Staff	Greene	Staff	Smith - Starre					
Scoping Mtgs	1	1	1													3	3
Contract Mtgs.	1	1	1													3	3
DEP Oversight Comm. (6)	2	4	3				2			1		2		1		15	15
Task Plan	1	2	3	3	3											12	
Status Report		1	3	2	3											9	
Problem ID Report		1	2													3	
Data Compilation		2	1	5	5		3	3	3		2					24	
Literature Research		2		5	5		2	3	2				3			22	
Manual Format		2	3				3					2				10	
Manual Outline		2	3							2		1		2		10	
Site Analysis																	
Site Factors and Analysis	2	5	5	3	2			1								18	
Building Program Issues																	
Twp. Zoning/SLDO	1	2	5		5		1		1							15	
Design Phase I- Preventative BMPs																	
Minimum Disturbance/Maintenance	1	2	7		3											13	
LID, Imp. Coverage, Lot Config.			5		5		1					3		10	5	29	
Stormwater Analysis and Methodology	3	5	5													13	
Design Phase 2. Mitigative BMPs																	
Infiltration measures	2	3		5	2											12	
Water Quality Measures	2	3		5			1	3	1							15	
Wetland Systems		1			1					3	3					8	
Vegetated Roof Systems		1		3		8										12	
Capture/reuse systems	1	2		3				1								7	
Detention systems		1				2		3	2	3	2					13	
Rain Gardens, Berms, Swales, etc	2	4		3	3											12	
Document Production																	
Final Edit	2	4	6				2	1						1	2	18	
Graphic, tables, format		1	4	3	6				2							16	
Final Report (Gray scale, 24)		1	2	1	3				3							10	
Electronic (Quark, 24 CDs)				1	2											3	
Interest Group Mtgs (5)	2	4	3	3	3		2	2		1		5	5	3	3	36	36
DEP Training Sessons (6)	2	3	4	4	2					2		6	6			29	29
Consultant Workshops (6)	1	3	4	4	4					1		6	6			29	29
		1														1	
TOTALS person-days	26	64	70	53	57	10	17	17	14	13	7	25	20	17	10	420	115
TOTALS hours	208	512	560	424	456	80	136	136	112	104	56	200	160	136	80	3,360	920
Contractor hours					2160	80			384		160		360		216	3,360	
Percent of total Labor					64%	2%			11%		5%		11%		6%		