SECTION II

Section II will provide additional project specific stormwater evaluation results using the ten (10) MassDEP stormwater regulatory standards.

MASSDEP STANDARD 1

The Massachusetts Stormwater Handbook states that ***no new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosions in wetlands or waters of the Commonwealth.*** The proposed **OSRD** stormwater systems are specifically designed to utilize the existing stormwater non-point source discharge points, as described in section 1 and depicted on both the pre & post-development watershed plans contained in the appendix of this report. Moreover, the proposed **OSRD** stormwater systems pre-treat, treat and store onsite stormwater, while providing groundwater recharge. The proposed stormwater system (Infiltration Basin) will create a single point source discharge (pipes with energy dissipating apron) upstream of the existing property line (Map 15, Lot1A), leaving over 60.0 ft of naturally undisturbed buffer. The individual onsite bio-swales/basins with be isolated low points designed only to capture, treat and infiltrate stormwater without formal outlets. In the event of high water or significant rain events (>25-yr), excess surface stormwater will sheet flow over land (largely vegetated) and be collected & transported into the project's stormwater basin. However there are two (2) instances on Lots 5 & 6 respectively where overflow will exit the residential lots through over 300 ft of undisturbed woodlands, prior to re-entering the wetland resources. As such, the proposed **OSRD s**tormwater systems do not include new stormwater conveyances of untreated stormwater directly to and will not cause erosion near, adjacent or in wetlands or waters of the Commonwealth.

To demonstrate treatment compliance with MassDEP standard 1, the stormwater systems include the following stormwater treatment measures, as permitted and specified in Volume 2 of the Massachusetts Stormwater Handbook; Deep Sump Catch Basins, Vegetated Filter Strips, Rain Gardens, Sediment Forebay and Infiltration Basin (dry), which are further described in the MassDEP Standard 4 narrative.

To further demonstrate erosion compliance with MassDEP standard 1, the **OSRD** stormwater systems include the following stormwater erosion protection BMP's, as permitted and specified in Volume 2 of the Massachusetts Stormwater Handbook; Riprap outlet protection apron and Erosion Control Matting (ECM). ECM's are used in specific slope stabilization applications, based on grade, slope distance, and total area, to reduce or eliminate non-point source potentially erosive scenarios. The riprap outlet protection aprons are used at specific point source stormwater outfalls, which are further identified and described below.

Project Outlet protection shall be 6" fractured stone, 18" depth, 8.0 ft wide and 16.0 ft long

I.D.	Lot #	Stormwater System	Peak Velocity (fps)		Description
			10-year (4.48")	25-year (5.60")	
HW-1	Lot-7	Sediment Forebay	4.7	6.4	15" Outfall from Roadway System

The project purposely positioned the proposed infiltration basin and pipe outfall (point discharges) at or near the subject parcel's perimeter, in order to mimic pre-development conditions.

MASSDEP STANDARD 2

The Massachusetts Stormwater Handbook states ***stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.*** The **OSRD** stormwater systems are specifically designed to mitigate peak discharge rates, while maintaining similar discharge points wherever practical. As such, the proposed **OSRD** stormwater systems do not anticipate peak discharge rate increases.

To demonstrate peak discharge rate compliance with MassDEP standard 2, the **OSRD** stormwater systems include the following stormwater mitigation measures; onsite Bio-Swale/Basins and (dry) Infiltration Basin, which are further described in the MassDEP Standard 4 narrative.

The **OSRD** stormwater system's peak discharge rates are summarized below for each of the three (3) comparative analysis points; (Type III, 24-hr events)

Analysis Point	Pre / POST	Peak Discharge (cfs)				Comments
		2-year (3.03")	10-year (4.48")	25-year (5.60")	100-year (7.88")	
A	Pre	1.9	4.7	7.2	12.6	Natural Channel (Map 15, Lot 9.6)
	POST	**1.7**	**4.3**	**6.6**	**11.5**	
B	Pre	1.6	4.1	6.3	11.2	Property Limits (Map 15, Lot 1A)
	POST	**1.2**	**3.4**	**5.5**	**10.8**	
C	Pre	3.2	8.1	12.4	22.0	Property Limits (Open Space)
	POST	**3.1**	**7.5**	**11.4**	**21.8**	

MASSDEP STANDARD 3

The Massachusetts Stormwater Handbook states ***loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices and good operation and maintenance.*** The proposed **OSRD** infiltration stormwater system(s) are specifically selected, positioned and site specifically designed to promote responsible and affective groundwater recharge practices within the Stormwater Manual design intent.

The **OSRD** required recharge volume is calculated as follows: **Rv = F x Imperious Area**

The "F" value or Target Depth Factor used is 0.25, in accordance with NRSC soil types on site. Please also refer to the onsite testing locations and results contained in the appendix. The anticipated total impervious area for the **OSRD** is **1.24 acres** (including the buildings, roadway, drives and walks – see also Rv worksheets)

Total Rv = (0.25 inches * 1/12 ft/in) x (**1.24*** 43,560 sf/1.0 acre) = 1,147 cf **Rv = 1,125 cf**

- **Analysis Point "A" Rv** = **0 cf** (no new anticipated attributable impervious surfaces)
- **Analysis Point "B" Rv** = **855 cf** (+/- 41,150 sf, internal project to infiltration basin.)
- **Analysis Point "C" Rv = 270 cf** (+/- 12,940 sf, all other areas not being routed to infiltration basin)

Using the "Static" method and computer generated volumes (HydroCAD ver 10.0) contained in the appendix, the **OSRD** stormwater systems groundwater recharge compliance with MassDEP standard 3, can be summarized below;

INFILTRATION SYSTEMS:

HydroCAD I.D.	Elevation (ft),	Volume (cf)	Comparison Point	Description
P4 and P5	(varies)	872	C	Bio-Swale/Basin, (2) areas @ 436 cf ea.
P1-P3, P6-P7	(varies)	2,180	B	Bio-Swale/Basin, (5) areas @ 436 cf ea.
PA	826.3	1,069	B	Infiltration Basin and Bio-Swale/Basin

Elevations & Volumes are based on outlet control (orifice – low flow) design

Therefore, the total available storage/recharge volume provided, based on low flow outlet control elevations (full volume) is **4,121 cf** (> 1,050 required), which equates to an approximate 3.9 design factor of safety.

Using the Rawls rate, the following equations can be used to establish the draw down time of each infiltration practice.

$$DT = \frac{Rv}{(K_{Rawls})\ (\text{Practice Bottom Surface Area})}$$

According to "Other Considerations", as defined in the MDEP Volume 3, Chapter 1, the proposed **OSRD** is considered a small residential project having five (5) to nine (9) single family residential homes. The proposed onsite and roadway stormwater measures will capture 100 % of the proposed impervious surfaces, with commensurate pre-treatment, treatment and attenuation. However, groundwater mounding is not considered applicable, since there are no planned discharges that may potentially affect critical areas. The proposed seven (7) individual Rain Garden(s) and the Infiltration Basin are purposely situated and conservatively sized to account for groundwater separation and potential break-out. Essentially, the proposed stormwater design is both responsible and reasonable to the maximum extent practical, given the proposed relatively low impact development and onsite land characteristics with all stormwater practices far upstream of both steep slopes and environmentally sensitive areas.

Applying the 1982 Rawls rates, given the textural material encountered within the recorded onsite test pits and considering the perc rates achieved (see appendix), the infiltration rate (constant velocity) used is **2.41 in/hr.** The **OSRD** stormwater systems groundwater draw down time compliance with MassDEP standard 3, can be summarized below; (see also Rv worksheets contained in the appendix)

INFILTRATION SYSTEMS:

HydroCAD I.D.	Surface Area (sf)	Conductivity (K) (In/hr)	Draw Down Time (hrs)	Test Pit(s)	Description
P1	450	2.41	4.8	914-3	Bio-Swale/Basin, Lots #1 & #2
P2	450	2.41	4.8	914-7	Bio-Swale/Basin, Lots #1 & #2
P3	450	2.41	4.8	--	Bio-Swale/Basin, Lot #4
P4	450	2.41	4.8	--	Bio-Swale/Basin, Lot #5
P5	450	2.41	4.8	--	Bio-Swale/Basin, Lot #6
P6	450	2.41	4.8	412-1 to 4	Bio-Swale/Basin, Lot #7
P7	450	2.41	1.8	914-1	Bio-Swale/Basin, Lots #8 & #9
PA	3,550	2.41	1.5	412-1 to 4	Lots #3 & #4 and Infiltration Basin

Surface areas (sf) are based on wetted area at full volume using outlet control design.

The "Rain Garden" design contained within the approved plans and modeled within the stormwater report are general in nature, while applicable to actual site conditions. The developer and site contractor will be responsible to design, implement and construct compliant LID measures meeting or exceeding those allowances described within the approved plans and corresponding stormwater model.

MASSDEP STANDARD 4

The Massachusetts Stormwater Handbook states ***stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).*** The proposed **OSRD** stormwater systems are acceptable TTS removal Best Management Practices (BMPs), as listed within the Massachusetts Stormwater table. The following BMPs are included with the **OSRD** stormwater systems:
(MassDEP TSS Worksheet contained in the report appendix)

- Rain Gardens (pre-treatment, 80 % TSS)
- Deep Sump and Hood Catch Basins (pre-treatment, 25 % TSS)
- Sediment Forebay (pre-treatment, 25 % TSS)
- Infiltration Basin (treatment, 80 % TSS)

MASSDEP STANDARD 5

The Massachusetts Stormwater Handbook states ***source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.*** The proposed **OSRD** is not considered a higher pollutant load site. The site's infiltration rates are not excessive and the anticipated traffic generation is insignificant, when compared to the regulatory thresholds.

MASSDEP STANDARD 6

The Massachusetts Stormwater Handbook states ***Stormwater discharges to a Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or any other critical area require the use of the specific source control and pollution prevention measures and the specific stormwater best management practices determined by the Department to be suitable for managing discharges to such area, as provided in the Massachusetts Stormwater Handbook.***

The proposed **OSRD** project is not located within a critical area and proposes to maintain existing stormwater patterns within significant similarity to the existing natural drainage patterns. Please also refer to standard 1 & 2 narratives, as well as the pre & post development watershed plans contained in the report appendix.

MASSDEP STANDARD 7

The Massachusetts Stormwater Handbook states ***A redevelopment project is required to meet the following Stormwater Management Standards only the extent practical: Standard 2, Standard 3 and the pretreatment and structural stormwater best management practice requirement of Standards 4, 5 and 6.***

The proposed **OSRD** project is a new development and is not considered a redevelopment project. Please also refer to the **OSRD** project narrative contained in section 1 of this report.

MASSDEP STANDARD 8

The Massachusetts Stormwater Handbook states ***A plan to control construction-related impacts, including erosion sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan), must be developed and implemented.***

The proposed **OSRD** project will prepare an Erosion and Sedimentation Control Plan that will be incorporated within both the special permit application plan set, in accordance with usual and customary engineering practices. In addition, the **OSRD** special permit application plan set includes a site specific Grading & Drainage Plan that depict project specific stormwater control measures and best management practices.

MASSDEP STANDARD 9

The Massachusetts Stormwater Handbook states ***A long-term operation and maintenance plan must be developed and implemented to ensure that stormwater management systems function as designed.***

The proposed **OSRD** project will prepare a Stormwater Operation and Maintenance Plan, in accordance with usual and customary engineering practices detailing, differentiating and describing the project specific stormwater practices to be implemented, monitored and maintained during construction and residency (Private Home Owners Association). The Stormwater Operation and Maintenance Plan will include specific and timely Stormwater Operation and Maintenance activities, duties and responsibilities along with corresponding specifications and checklists to insure affective and accurate observation, operations and maintenance actions are regularly performed. BMP specific checklist will also be included to document and record compliance with the intended Stormwater Operation and Maintenance activities.

MASSDEP STANDARD 10

The Massachusetts Stormwater Handbook states ***All illicit discharges to the stormwater management system are prohibited.***

The proposed **OSRD** project does not anticipate any illicit discharges. In addition, the Home Owners Association (HOA) documents will include the proposed stormwater systems description and purpose, including specific illicit discharge literature. All potential and existing residents will be made aware within the real-estate sales advertisements and HOA documents of the illicit discharge program. Lastly, illicit discharge signage (MUTCD type signs) will be posted throughout the site, as well as placards on all open frame and grates.

All residents will be required to read, review, acknowledge and sign the following statement, in compliance with the HOA documents:

Illicit Discharge Compliance Statement

To the best of my knowledge no illicit discharges currently exist on the site and no future illicit discharge will be allowed, including wastewater discharges and stormwater discharges contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease.

_____

Signed by Owner *Date*