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April 15, 2025

Mr. Justin DeBrodt, Chairman
Inland Wetlands and Watercourses Commission
Town of Ledyard
741 Colonel Ledyard Highway
Ledyard, Connecticut 06339

RE: Application IWWC #24-9
C.R. Klewin, LLC
19, 29, & 39 Military Highway
Ledyard, Connecticut

Dear Mr. DeBrodt and Members of the Inland Wetlands and Watercourses Commission,

I have been retained by the Gales Ferry District to perform a third-party civil engineering review of the above referenced project. I have reviewed the following plans and documents.

Documents and Plans Reviewed:

a. FD #1 – Application
b. FD #2 – Application Narrative
c. FD #5 – Site Plans by Bohler Engineering
d. FD #4 – Epicc Clean Tech Calculations
e. FD #6 – Drainage Report by Bohler Engineering

Executive Summary:

A. The stormwater management basins and design computations are not in compliance with the CT DEP 2004 Storm Water Quality Manual and will result in increased pollutant loads being discharged from the site which will reach the downgradient wetlands.
B. The erosion and sedimentation control plan are not in compliance with the CT DEP 2022 Guidelines for Soil Erosion and Sediment Control and will result in the discharge of turbid water during the construction period.
C. No design information has been provided for the on-site sewage disposal system so potential impacts to wetlands and watercourses cannot be evaluated.

I have the following comments and concerns for consideration by the Inland Wetlands and Watercourses Commission for the Town of Ledyard.

Application Narrative:

1. No evidence has been provided by the applicant to prove that there will be no long-term impacts on wetlands or watercourses (Consideration C).
2. No evidence has been provided by the applicant that the project will not result in an irreversible and irretrievable loss of wetland or watercourse (Consideration D).
3. Because of increased peak rates of runoff, increases of runoff volumes and increased pollutant loads, there will be adverse impacts on downgradient wetlands and watercourses. Increased runoff volumes will cause adverse impacts to stream channel morphology which will result in the deposition of the eroded material from a stream channel in a lower section of the watercourse. Increased pollutant loads will change the water quality within a wetland and watercourse over time, thus making the aquatic environment less desirable for aquatic animals.

Site Plans

Sheet C-301:

4. No vehicle turning movements are shown which would demonstrate that emergency vehicles can fully access the site. If the emergency vehicles are not able to fully access all the residential units, this would require changes to the site design and the requested regulated activities.

Sheet C-401:

5. A dashed line is shown marking the extent of the possible sewage disposal system, but no information has been provided on the actual design of the leaching system. While the sewage is located outside the defined upland review area, it will likely have adverse environmental impacts on the downgradient wetlands due to inadequate treatment of the effluent.
6. A rain garden is shown to the west of Building B. No deep test holes or infiltration tests have been done as required by the CT DEEP 2024 Storm Water Quality Manual "2024 Manual). Thus, the design is not in compliance with the 2024 Manual.
7. It is stated on the plan that the bottom of Rain Garden C will be set at 34.50', however, the lowest contour shown in 36.0' so it cannot be determined where the true bottom of the Rain Garden is set at.
8. Only catch basins and online hydrodynamic separator are proposed by the applicant prior to directing runoff to underground detention systems. The catch basins and online hydrodynamic separators will not provide adequate treatment of runoff to reduce non-point pollutant loads as required by the 2024 Manual.
9. These systems will only remove the following percentages of non-point source pollutant loads:
    a. Catch Basins with 48" deep sumps (University of New Hampshire Stormwater Center):
        i. Total Suspended Solids = 9%
        ii. Total Petroleum Hydrocarbons = 0%
        iii. Metals = 0%
        iv. Phosphorous = 12.5%
        v. Nitrogen = 0%

b. Online Hydrodynamic Separators (University of New Hampshire Stormwater Center):
    i. Total Suspended Solids = 29%
    ii. Total Petroleum Hydrocarbons = 42%
    iii. Metals = 26%
    iv. Phosphorous = 0%
    v. Nitrogen = 0%

c. Online Hydrodynamic Separator (ASCE BMP Database):
    i. Total Suspended Solids = 38%
    ii. Metals = 21.6%
    iii. Phosphorous = 23%
    iv. Nitrogen = 9.4%

10. The 2024 CT DEEP Storm Water Quality Manual requires the following percent reductions of certain non-point source pollutants for Re-developments:
    d. Total Suspended Solids = 80%
    e. Total Phosphorous = 50%
    f. Total Nitrogen = 30%
11. The proposed infiltration basin (1E) in the southwest portion of the site has a cut on the west side of the basin of 16' below the existing grade. No soil testing has been conducted in this basin to determine if the soils are suitable. No infiltration tests have been conducted at or below the bottom of the basin. The design of Basin 1E is not in compliance with the 2024 Manual.
12. No soil testing has been conducted in Basin 1D to determine if the soils are suitable for infiltration. It has not been demonstrated that the required vertical separations in the 2024 Manual to seasonal high groundwater and/or bedrock are met. No infiltration tests have been conducted at or below the bottom of the basin. The design of Basin 1D is not in compliance with the 2024 manual.
13. There is no forebay for infiltration basin ID which is required by the 2024 Manual. Thus, the design is not in compliance with the 2024 manual.
14. Soil borings B-2 and B-9 may have been done in the vicinity of Basins 1D and 1E. Glacial Till was encountered at 2.5' below grade in B-2, and at 2.0' below grade in B-9. Glacial Till is a restrictive soil layer with a perched groundwater table on top of the till layer, thus infiltration basins would not function if located near B-2 and B-9.
15. The StormTrap system (UG-1F) is located under the parking area which is south of Building A. The bottom of the stone is proposed to be at 29.5' which is between 2.5' and 4.5' below the existing grade. Based upon TP-5, seasonal high groundwater was observed at 5.8' below existing grade, yet no groundwater was encountered in TP-4 which was done on the same contour as TP-5. Because of this difference, groundwater monitoring during the wet system (February to May) must be done to determine the extent and depth of the seasonal high groundwater under this system.
16. The regraded slope above infiltration basin 1E is up to forty (40) feet in height. There are no reverse benches provided to prevent runoff running down the entire length of the slope per standard engineering practice and required by the CT DEEP 2024 Guidelines for Soil Erosion and Sediment Control.

17. There is no cut off drain at the top of the slope to intercept shallow groundwater and surface runoff from saturating the slope. Groundwater will saturate this slope overtime and cause a failure of the slope.
18. The slope above the western parking is 36' in height with no reverse benches or cut off drains. This situation is not in compliance with the 2024 Guidelines.

Sheet C-402:

19. The forebay for Basin 1E will not function as intended to trap coarse and medium sediments. The invert of one of the pipes entering the basin is at 30.11', the invert of the second pipe is at 31.00 with the bottom of the forebay being at 30.00'. Flow from the pipes into the shallow forebay (only 2' in depth) will cause the resuspension of any trapped sediments when new flows enter the basin. The resuspension of settled sediments will then flow over the berm in the main body of Basin 1E and result in the clogging of the bottom of Basin 1E.
20. Scour holes are shown at the outlets of the pipes at A-10, B-10, B-40, and B-41. Scour holes will maintain concentrated flow from the outlet pipes. Concentrated flow over time will cause erosion of the downgradient upland slopes which could result in sediment deposition in the delineated inland wetland area.

Sheet C-501:

21. An online of the potential sewage disposal system is shown on the plan, but no other design information has been provided. This is a serious omission on the plans for this project.
22. No treatment system is provided for effluent prior to being directed to the sewage disposal system.

Sheet C-601:

23. Slope stabilization is shown for the steep regraded slopes along the west side of the site. This does not eliminate the need for reverse benches and slope drains per the 2024 Guidelines.
24. There is no phasing plan with appropriate erosion control measures for each phase. As proposed a total of approximately 10 acres will be disturbed. The CT DEEP Construction General Permit limits site disturbance to five (5) acres at one time.

Sheet C-602:

25. The construction sequence is inadequate for a project of this size. The form and content of the construction sequence is not in compliance with the CT DEEP 2024 Soil Erosion & Sediment Control Guidelines (2024 Guidelines).

Sheet C-701:

26. It is proposed to use a wet seed mixture on the bottom of both infiltration basins. For this seed mixture to germinate and become established, it needs wet conditions. If wet conditions exist in an infiltration basin, then the infiltration basin will not infiltrate water as the soils are saturated.

Sheet C-903:

27. The detail of the infiltration basin is generic and not site specific to this project.

Sheet C-904:

28. The detail of the Bioretention is not site specific and appears to be from another project by the applicant.
29. This detail shows an underdrain, but no underdrain is shown on the site plan.
30. The detail calls out a layer of filter fabric under the soil media and above the pea gravel layer. This layer will cause clogging of the system and failure of the bioretention system.
31. With an underdrain shown at the bottom of the bioretention system, this means that the system is not designed to infiltrate runoff which would reduce runoff volumes.
32. The soil media specified will result in clogging of the soil media as the clay content will exceed 2%. This result has been documented in research.

Drainage Report:

33. It is stated on page 6 of this report that runoff will be directed to either an underground infiltration system or infiltration basin. As noted above, it has not been proven by the applicant that underground infiltration systems or basins will function on this site.
34. It is stated on pages 6 & 7, the water quality volume (WQV) is being provided in the proposed underground and above ground basins and thus pollutant renovation will occur. This is not correct. Simply providing a volume does not equate to treatment and reduction of non-point source pollutant loads, such as Total Suspended Solids, Total Phosphorous, Total Nitrogen, Metals and Hydrocarbons. Many physical, chemical and biological process must occur for the reduction of these types of pollutants which are not being provided in the design by the applicant.
35. As required soil testing per the 2024 Manual has not been done, the claims of meeting the Runoff Reduction Volume (RRV) are unsupported.
36. If no infiltration occurs, then the RRV will not be met.
37. As unsupported infiltration rates are used in the routing analyses of all stormwater basins, the claims of peak rate reduction are also not valid.
38. An infiltration rate of 4.135"/hour was used in the routing analysis for the StormTrap system. This is 50% of the Rawls Rate (National generalized soil infiltration rates from 1982) for Sand and Gravel soils. Based upon the results of TP-4 and TP-5, the soils are not sand and gravel. In addition, the 2024 Manual requires that on-site infiltration testing be done. Rawls rates are only for preliminary assessment of site conditions.
39. An infiltration rate of 0.5"/hour was used for Rain Garden 1C which is not supported by on-site field infiltration testing.
40. An infiltration rate of 4.135"/hour was used in the routing analysis for Infiltration Basins 1D and 1E. This is 50% of the Rawls Rate (National generalized soil infiltration rates from 1982) for Sand and Gravel soils, In addition, the 2024 Manual requires that on-site infiltration testing be done. Rawls rates are only for preliminary assessment of site conditions.
41. Based upon the missing or inadequate soil testing conducted by the applicant, it is highly likely that no infiltration will occur in any of these stormwater practices, thus there will be increases in the peak rate and volume of runoff for all storm events.

42. The applicant states that Table 4-2 of the 2024 CT DEEP Storm Water Quality Manual does not require an evaluation of the pollutant loads as long as the Water Quality Volume is provided. This is not what Table 4-2 states. Table 4-2 clearly states that "if the volume retained meets or exceeds the RRV (Required Retention Volume), then no additional treatment volume is required." It does not eliminate the need to determine the pollutant loads and evaluate how the treatment system will reduce the pollutant loads prior to discharge to either a wetland or groundwater. Table 4-2 is provided below. **Applicant quotes from page 48 of the 2024 Storm Water Quality Manual if the full WQV is provided, "then it is assumed pollutant load reduction is also achieved and individual pollutant load calculations are not necessary." This assumption by the author of the DEEP Manual is incorrect and not supported by years of field monitoring data across the US. A reminder to the applicant, that the 2024 Manual is only a "guideline". The obligation of a Professional Engineer's under Section 20-299 of the CT General Statutes is to design systems to protect the public welfare or the safeguarding of life, public health or property is concerned or involved;". To meet this requirement engineers must go beyond any standard or guideline as necessary**.

Table 4-2. Required Retention Volume Determination

Type of Project or Activity	Required Retention Volume (RRV)[1]	Additional Treatment Volume Required[1]	
		If Volume Retained Meets or Exceeds RRV	If Volume Retained Does Not Meet RRV
➢ New development[2] ➢ Redevelopment[3] or retrofit of sites that are currently developed with existing DCIA[4] of less than 40% ➢ Any new stormwater discharges located within 500 feet of tidal wetlands, which are not fresh-tidal wetlands, to avoid dilution of the high marsh salinity and encouragement of the invasion of brackish or upland wetland species	100% of site's WQV	None	(100% of site's WQV) – (Volume Retained)
➢ Redevelopment or retrofit of sites that are currently developed with existing DCIA[4] of 40% or more	50% of site's WQV	None	(100% of site's WQV) – (Volume Retained)

[1] Provide stormwater retention or additional treatment without retention to the Maximum Extent Achievable as defined in the CT DEEP stormwater general permits and described in this section.

[2] "New Development" means any construction or disturbance of a parcel of land that is currently in a natural vegetated state and does not contain alteration by man-made activities.

[3] "Redevelopment" means any construction activity (including, but not limited to, clearing and grubbing, grading, excavation, and dewatering) within existing drainage infrastructure or at an existing site to modify, expand, or add onto existing buildings, structures, grounds, or infrastructure.

[4] For the purpose of determining the Required Retention Volume, existing DCIA should be calculated based on the existing (pre-development) conditions of the overall project site.

Chapter 4 – Stormwater Management Standards and Performance Criteria 40

Whitestone Soil Report:

43. It is stated on page 3 of this report that infiltration rates for I-1, I-2, I-3, & I-4 all exceeded 15" per hour approximately 1.5' below existing grade in cased holes. None of the actual field readings over time have been provided for these test results. An

infiltration rate of 15”/hour is very fast and infiltration into this soil profile will not provide any treatment of the runoff as the runoff moves too fast through the soil profile.

44. The above infiltration tests were also done less than 3’ below the ground surface and the bottom of all stormwater systems are substantially deeper than 3’, so these results cannot be used in the modeling of the stormwater practices as the 2024 Manual requires the infiltration tests to be done at or below the bottom of the stormwater practice.
45. TP-4, TP-5, and TP-6 are all located in the vicinity of the StormTrap system south of Buildings A. The description of the soil layer below the topsoil calls out Brown to Grey, poorly graded sand with silt. Based upon my forty years of excavating test holes, poorly graded sand with silt will not have an infiltration rate of 15”/hour as the silt content is a slower draining soil.
46. No particle size distribution was done for this soil layer. Why wasn’t this layer tested?
47. Percolation tests were done in TP-4, and TP-5. Percolation tests cannot be used for the design of infiltration system per the 2024 Manual.

Epiccleantec Report of February 20, 2025:

48. According to this document, the peak daily discharge to be generated by this development is 69,000 using 150 gpd per bedroom. This is greater than the prior development application.
49. No information has been provided on the design of the large scale on-site sewage disposal system. The lack of this information prevents an evaluation of the adverse environmental impacts on downgradient wetlands and watercourses on this site.
50. Epiccclentec is using Table 8 from the Current Technical Standards of the Connecticut Public Health Code. This table is only applicable for daily effluent flow rates which are less than 7,500 gpd. The Design Manual by the CT DEEP of 2006 for Large Scale On-site Sewage Disposal systems require the use of an application rate of 0.8 gpd per square foot of effective leaching area. Using a rate of 0.8 gpd per square foot of effective leaching area, would require the leaching area to be 86,250 square feet which is 50% larger than the 57,500 square feet cited in this report.
51. Groundwater monitoring must be done weekly during the defined wet season (February 1st to May 31st) in a calendar year to define the consistent seasonal high groundwater table over a 30 day period during this time of the year assuming that there is average snowfall and/or rainfall during this period. This work has not been done by the applicant. The seasonal high groundwater table must be determined because the depth of the Groundwater Mounding analysis will be added to the elevation of the seasonal high groundwater table. The bottom of the leaching system is then set two (2) feet above the elevation of the seasonal high groundwater table and the height of the Groundwater Mound. Without the proper groundwater monitoring, it cannot be determined if the system will function as intended and can be accommodated on the site as proposed.
52. No information has been provided for the proposed wastewater treatment plant showing factual data for the reductions of nitrogen, phosphorous and bacteria/virus concentration which will be discharged from the plant. It is not up to the CT DEEP to set these standards, it is the responsibility of the design professional to propose a system which will not cause adverse impacts to wetlands and watercourses.

Please contact my office if you have any questions concerning this review.

Respectfully submitted,
Trinkaus Engineering, LLC

Steven D. Trinkaus, PE

APPENDIX "A"
INFORMATION ON TREATMENT SYSTEMS IN SERIES

Town of Shelbyville, KY – Stormwater Management Practices – January 2013
Bottom of page 2-18 states the following: *"When two or more BMPs are used in series (stormwater discharges from one BMP into another), a different calculation is necessary. This scenario is called a **treatment train**. Stormwater discharging from the upper most BMP will be considerably "cleaner" than the influent, meaning TSS particle sizes will be much smaller. Pollutant removal rates for BMPs used in a treatment train are not additive. For pollutants in particulate form, such as TSS, the actual removal rate (expressed in terms of percentage of pollution removed) varies directly with the pollution concentration and sediment size distribution of runoff entering a facility. For example, a stormwater treatment pond will have a higher pollutant removal percentage for very turbid runoff than for relatively clear water. When stormwater ponds are placed in series, the downstream pond will treat incoming TSS load that is very different from the upstream pond. The upstream pond easily captures the larger solids and discharges an outflow that has a lower concentration of TSS, but with a relatively higher proportion of fine particle sizes. Therefore, further TSS reduction will be difficult for the second and subsequent BMPs. Hence the TSS removal capability of the downstream pond is considerably less than the upstream pond. Recent studies suggest that the downstream pond in a series can provide as little as half the removal efficiency of the upstream pond."*

August 24, 2018 PowerPoint presentation entitled "Grant application to quantify the pollutant removal capabilities of select stormwater best management practices" by Pinelands Policy and Implementation Committee.
"BMPs can be linked in series (a "treatment train") to attain a higher pollutant removal rate. However, the actual removal rate is not simply additive."

New Hampshire Department of Environmental Services – Alteration of Terrain Manual – Pollutant Removal Efficiencies for Best Management Practices for Use in Pollutant Loading Analysis.
"Adding efficiencies together is generally not allowed because removals typically decrease rapidly with decreasing influent concentration and, in case of primary BM:s (i.e. stormwater pond, infiltration and filtering practices), pre-treatment is usually part of the design and is therefore, most likely already accounted for in the efficiencies cited for those BMPs."

Murfreesboro, TN – Section 2.1.6 Using Structural Stormwater Controls in Series Subsection 2.1.6.3 Calculation of Pollutant Removal for Structural Control in Series
"For two or more structural stormwater controls used in combination, it is often important to have an estimate of the pollutant removal efficiency of the treatment train. Pollutant removal rates for structural controls in series are not additive. For pollutants in particulate form, the actual removal rate (expressed in terms of percentage of pollution removed) varies directly with the pollution concentration and sediment size distribution of runoff entering a facility."

Center for Watershed Protection – Runoff Reduction Method Technical Memo – Appendix F: BMP Research Summary Table – April 15, 2016
Page F-41 (Hunt and Lord, 2006): "Cleaner stormwater runoff appears to decrease pollutant removal efficiency."

National Pollutant Removal Performance Database, Version 3 – September 2007
Page 3/10 – Incoming Pollutant Concentrations – In addition, pollutant removal percentages can be strongly influenced by the variability of the pollutant concentrations in the incoming stormwater (Schueler, 2000b). If the concentration is near the "irreducible level" (Schueler 2000a), a low or negative removal percentage can be recorded, even though outflow concentrations discharged from the BMP are relatively low. In other words, if relatively clean water is entering a BMP, then there is limited performance potential that can be achieved by the BMP. BMPs that treat the dirtiest water (runoff with relatively high pollutant concentrations) are likely to achieve higher percent removals."

APPENDIX "B"
DESCRIPTION OF WATER QUALITY IMPAIRMENTS DUE TO NON-POINT SOURCE POLLTUANT LOADS

The following is a summary of the potential water quality impairments that will occur in the receiving wetlands and watercourses. A discussion of the impacts of increased runoff volume on aquatic systems is also provided.

Total Suspended Solids (TSS)

Total Suspended Solids are fine soil particles, such as silt, and clay which are dissolved in water. In excessive amounts it causes turbidity in water. The turbidity blocks light in the water column which causes reduced photosynthesis, which in turn reduces the oxygen levels in the water. Coarse and fine sediments can clog the gravel substrate in breeding streams thus affecting the biological community's ability to reproduce. Common sources of TSS and sediment are runoff from construction sites, winter sanding operations, atmospheric deposition, and decomposition of organic matter, such as leaves. Turbidity is measured as NTU.

Nutrients (TN & TP)

Phosphorus and nitrogen are commonly found in non-point runoff with the primary source being lawn fertilizers. Excessive levels of phosphorus in freshwater systems are a concern as this nutrient causes excess growth of non-native aquatic plants and algae in lakes. As a result of increased nutrient loads, toxic algae blooms are becoming more prevalent in lakes in Connecticut. These toxic algae blooms have resulted in beach closures as exposure to the algae blooms can cause adverse health issues in humans. A further problem occurs, when the algae die off, the decomposition process of organic matter removes oxygen from the water column, thus reducing oxygen levels in the water. The reduced oxygen levels in the waterbody can result in fish killings. Nitrogen, in the form of nitrate, is a direct human health hazard and an indirect hazard in some areas where it leads to a release of arsenic from sediments. While not a major concern for freshwater systems, nitrate can cause environmental impacts in tidal regions, even though the source of nitrate can be far away from coastal regions. Sources of nutrients are organic and inorganic fertilizers, animal manure, bio solids and failing sewage disposal systems.

Metals (Zn)

Metals in non-point source runoff are very toxic to aquatic life. The adverse effects of metals are far reaching for both aquatic and human health. Many metals can bio accumulate in the environment, which can affect higher living organisms. While the concentration of zinc or copper in stormwater is not high enough to bother humans, these same concentrations can be deadly for aquatic organisms. Many microorganisms in soil are especially sensitive to low concentrations of cadmium. Zinc, Copper, and Cadmium found in non-point source runoff result from the movement and wear and tear of automobiles on our roadways.

Of the above discussed metals, zinc and copper are the two metals which are found dominantly in non-point source runoff. Metals commonly bind themselves to sediment and organic matter in stormwater and thus are transported to the receiving waters. Since natural rainfall is slightly acidic, metal roofs or components on the roof can be a significant source of the zinc or copper concentrations in stormwater.

Hydrocarbons (TPH)

Total Petroleum Hydrocarbons (TPH) are highly toxic in the aquatic environment, especially to aquatic invertebrates. The primary sources of petroleum hydrocarbons are oil, grease drops from automobiles, gas spills, and vehicle exhaust. Polycyclic Aromatic Hydrocarbons (PAHs) are also toxic to aquatic life. PAHs can be discharged into the environment using coal tar asphalt sealants, commonly used by homeowners on residential driveways. The movement of vehicles or people walking over the sealed driveway can release dust particles containing PAH, which can then be washed off with the next rainfall into the stormwater management system. PAHs are also generated by the burning of fossil fuels and the airborne particles are then deposited by atmospheric deposition on an impervious surface, especially large flat roof areas. When it rains, the accumulations of PAHs due to atmospheric deposition are carried off in the stormwater.