

April 14, 2010

Soil Report 622

County: Fauquier

Property Owner or Principal: Monday Properties Services, LLC

Date of Evaluation: March 2-3, 2010

Requested By: Charles Shepherd—Environmental Health Manager, Rappahannock-Rapidan Health District  
Present During Evaluation: March 2, 2010—Danny Hatch, Bennette Burkes—PE, Kemper Loyd, Jim Sawyer, Don Jeanrenaud, Ted Bullard, Tim Boren (backhoe operator) and Phillip Cobb. On March 3 everyone above was present except for Kemper Loyd.

Site Location: Catlett community in southeast Fauquier County

### Site Description

The sites are in the Triassic basin in southeastern Fauquier County. The total site consists of a 793 acre tract in farmland and mature woodlands. The evaluation sites are being proposed for mass drainfields to service a very large residential and commercial development that will generate about 400,000 gallons per day of wastewater (see enclosed Executive Summary and other material by Bennette Burkes, P.E., 3-Engineering; LLC, Richmond, VA). The proposed drainfield sites are in fields and mature hardwoods. The drainfield sites are on summits, shoulders, backslopes, footslopes, toeslope, and saddle landforms. The soils evaluated have developed in Triassic siltstones, shales, fine grained sandstones, igneous intrusions including diabase, and thermally altered redbeds. About 28 soil profiles were evaluated in and around the proposed drainfield areas using freshly dug backhoe pits.

### Soil Profile Descriptions, Classifications, and All Field Notes

March 1, 2010: Telephone call with Danny Hatch (project soil consultant and AOSE) on the Village of Catlett subdivision; **Hatch provided the following information:**

Jim Sawyer (Fauquier County Soil Scientist) has already looked at the soils in detail; Sawyer has roughly grouped soils for use and management while Hatch has grouped soils in somewhat different way; all the soils are derived from Triassic sedimentary, thermally altered (contact metamorphism) and igneous intrusions; according to Hatch, area and region has had 55 inches of snow in two past months and the soils are at their maximum wetness; Hatch has developed a detailed soil map of the project at a scale of 1:400; proposed about 17 areas that groups soils for the Catlett project; project needs 100% reserve; Fauquier County Service Authority is 'onboard' for the Catlett project; project will have tertiary treatment.

**More Hatch Information**—Best soil for drainfield is Panorama soil but the amount/area of this soil is limited; most of the drainfields will go into the Penn soil; worst soils are Jackland, Haymarket and Dulles soils; open fields are where most of the drainfields will be installed; loading rates are area based and not trench bottom based; Hatch and Burkes are generally proposing drip lines at 6 inches below the soil surface; the lowest rate used in design is 0.037 gpd while the highest rate is 0.3 gpd; final product will be a tertiary system owned by Fauquier County Service Authority; Catlett project will go forth as a HB 1166 proposal; Hatch did not use standard health department separation distances to soil limitations; Hatch has conducted about 57 Ksat tests using Johnson meter across all major soils and landforms; thermally altered soils include Kelly, Ott, and Sycoline; igneous intrusions of diabase are big ridge makers and have Jackland and Haymarket soils with tiny area of Montalto soil; Hatch has evaluated about 450 pits; Sawyer has reviewed all these profiles on paper and some in the field; Catlett project has used 400,000 gpd of wastewater in initial design; also used service authority figure of 250-300 gpd per housing unit; project to have about 95,000 square feet of retail space with a future school etc; project is using a 15 year build out in initial design and plans; first usage will include Old Catlett community which has many failing drainfields.

Executive Summary indicates that: "The study concludes that a proposed site has a minimum capacity to receive and disperse approximately 818,000 gallon of treated wastewater daily." Also, the project is in the Occoquan Watershed, which prevents Monday Properties from using a direct discharge system since subsurface dispersal is the only allowable method for treated wastewater discharge.

**In the field on March 2, 2010** evaluating the proposed drainfield sites; weather cold and spitting light rain most of day; patches of snow on ground but all landforms are easily observed; typical gently rolling Triassic landscapes; in Hatch's Area 10 which should be considered as having a 0.3 gpd design rate; diabase is the dominant igneous rock over the project area; "workable soil" is defined as generally permeable soil material without significant limitations such as wetness, plasticity, cementation, platy structure or restrictiveness; it does not imply that the entire soil profile is suitable for a drainfield; example: Ap horizon with loam texture overlying shrink-swell clays.

**Profile 18** is Haymarket soil; on gently sloping convex summit with 2 to 7% slopes; depth to restrictions is 8 inches and includes very high shrink-swell clays with very high clay content and plasticity; have CBt horizon beginning at 26 inches that includes clayey materials and diabase parent material and rock increasing in content with depth; Sawyer says profile 18 does not have gray redox to be considered a good Jackland soil; Profile 18 only has 8 inches of workable soil for a drainfield; Profile 18 is in the Soil Survey 167 soil map unit.

**Profile 19** is on a gently sloping (2 to 7% slopes) backslope; is Haymarket soil trending to Legore soil; very high shrink-swell and very high clay content soil materials begin at 10 inches; has thick Ap horizon with tongues of material into the upper Bt horizon; C/CBt horizons begin at 26 inches; no chroma 2 or less redox observed to 60 inches; profile is derived from diabase residuum; Profile 19 has about 10 inches of workable soil and is in the 167 soil map unit.

**Profile 20** is on a summit with 1% slope; profile is Sudley or Panorama like; has about 35 inches of transported soil materials with A and Bt horizons over a 2Bt at 35 inches that is dark reddish brown (5YR 3/4) to reddish brown (5YR 4/4) clay loam; at the 2Bt boundary have 10 to 15% content of subrounded quartz gravels; structure is moderate subangular blocky but is broken by the high gravel content; also have a few cobble sized rock fragments; discussion over whether the subrounded gravel represent colluvial or transported soil materials, or whether the parent rock contained subrounded gravels; Profile 20 is the best soil so far for a drainfield with A and Bt horizons having workable soil materials; however, any drainfield would still be alternative and have a shallow installation; Profile 20 is soil mapped as 71B, which consists of a little bump of Panorama soil.

**Profile 21** has about 21 inches of workable soil before encountering fractured siltstone with rock controlled structure; rock faces have many black manganese oxide concentrations; from 0 to 21 inches have very channery silt loam Bw or Bt horizons; Ap horizon has moderate medium subangular blocky structure; profile is Penn or Penn-like according to Sawyer

**Profile 22** is on a broad shoulder to upper backslope with estimated slopes of 2 to 7%; free standing water is at 26 inches below soil surface; have fractured redbeds at 18 inches with many very pale brown (10YR 7/3 and pink (7.5YR 7/3) iron depletions on rock faces; at 18 inches also have many pinkish gray (7.5YR 7/2) iron depletions on rock faces and many black (10YR 2/1) manganese oxide coatings on rock faces; Profile 22 field classifies as a Wet Penn trending to wet Nestoria; have about 14 inches of workable soil.

**Profile 23** is on upper backslope of upland drainageway and is Wet Nestoria according to Sawyer; Tim B. had dug pits earlier in the morning so free water in the pit has pretty much stabilized; Profile 23 has abundance of iron depletions at 11 inches below the soil surface; have moderately hard, blocky siltstone Cr beginning at 14 inches below the soil surface; many black manganese oxide coatings/concentrations on rock faces; have many seeps at the top of the Cr horizon; overall, Profile 23 is on a marginal landform and has additional soil limitations including shallow depth to Cr, redox features, and free standing water; Profile 23 has only 9 inches of workable soil.

**More Field Notes**—Service Authority will only have control/protocol of the finished project; field discussion on installation depth; Burkes and Hatch indicate that iron depletions and other wetness features are not a deal killer for the Catlett project and they can be "handled" in the engineering part of the project; Service Authority will develop and work with a "term sheet" with input from Burkes and Hatch; Burkes and Hatch indicate we should think about project in terms of a "non point treated wastewater discharge system."

**Profile 24** is a good Jackland soil on a convex summit/shoulder landform with estimated 2 to 10% slopes; in mature hardwood forest; have abundant diabase cobbles and stones on soil surface; beginning at 5 inches is high clay content Bt horizon with prismatic structure; clays have very high shrink-swell potential and very plastic; BC horizon beginning at 30 inches consisting of clayey material and diabase parent material; have several seeps in the Bt horizon; 3 inches workable soil.

**Profile 25** is on a 2 to 10% footslope and is Ott to Brecknock soil; Ott and Brecknock are separated in classification by difference in solum depth with Ott having a 20 to 40 inch solum; Profile has about 30 inches of workable soil; have CBt horizon at 34 inches that is very cobbly clay loam; rock content increases in content with soil depth; profile appears to be derived from greenish, thermally altered siltstone; profile in field of wheat stubble.

**Profile 26** is Wet Penn and is on a 2 to 7% footslope and in wheat stubble; pronounced chroma 1 and 2 redox depletions at 17 inches; many seeps at 18 inches and is at contact between Bt and Cr horizon beginning at 18 to 20 inches; have about 14 inches of workable soil.

**Profile 27** is a Wet Penn soil and has free standing water at 29 inches; pit dug a short while ago; have many gray redox depletions at 17 inches which is at contact of fractured redbeds; profile has 14 inches of workable soil.

**Evaluating Catlett Mass Drainfield soils on March 3, 2010 with same people present as at 3/2/10 evaluation except for K. Loyd; weather is better today.**

**Profile 28** is a Very Wet Nestoria and is on a long, lower toeslope merging into upper reaches of the upland drainageway; estimated 1 to 4% slopes; have free standing water at 15 inches with many chroma 2 or less iron depletions and reddish iron concentrations at 8 inches below the soil surface; have Cr horizon at 10 inches with many black manganese concentrations/coatings on rock faces; profile is colluvium over shallow redbeds; have seeps riding on top of redbeds; profile in wheat stubble.

**Profile 29** is Wet Penn to Ashburn soil with Ashburn probably the best call; profile is on a long footslope with estimated 2 to 4% slopes; profile is colluvium over wet redbeds; have free standing water at 28 inches; have fractured redbeds at 18 to 22 inches with many black manganese oxide concentrations/coatings on rock faces; profile has thick Ap horizon.

**Profile 30** is moderately well drained and is Sowego soil according to Sawyer; profile is on long, gently sloping footslope with overall slopes of 1 to 4%; Profile 30 has free standing water at 32 inches and has a very thick Ap horizon that is 18 inches thick; profile is in wheat stubble.

**Profile 31** is in wheat stubble and is on an upper footslope with estimated 2 to 7% slopes; profile is Wet Penn according to Sawyer; have free standing water at 29 inches; have chroma 1 and 2 iron depletions at 19 inches; have very shaly CBt horizon from 12 to 19 inches; Ap horizon is 8 inches thick; have 15 inches of workable soil.

**Profile 32** is a gently sloping summit landform with estimated 2 to 7% slopes; profile is Penn soil and is in wheat stubble; has several seeps riding on top of Cr horizon; have 15 to 20 inches of workable soil; Profile 32 is described below.

Ap--0 to 9 inches; brown (7.5YR 4/3) heavy silt loam; weak medium subangular blocky structure; 7% channers  
B11--9 to 15 inches; reddish brown (5YR 5/3) channery silty clay loam 30% channers blocky structure;  
B12--15 to 20 inches; reddish brown (5YR 4/3) very channery silty clay loam; 55% channers;  
Crt--20 to 34 inches; reddish brown (5YR 4/3) fractured siltstone with brown (7.5YR 4/3) iron depletions on rock faces

**Profile 33** is a Nestoria soil and is on a summit/shoulder landform with estimated 2 to 7% slopes; Crt horizon begins at 12 inches.

**Profile 34** is a Wet Penn according to Sawyer and is on an upper footslope with measured 4% slope; free standing water in the pit bottom that is 14-16 inches below the soil surface; pit depth is 42 inches; have 14 inches of workable soil.

**Hatch Info**—#12 Area is proposed active install or primary drainfield; #5 Area is proposed reserve area.

**Profile 35** is a Shallow Sowego with platy structure in the Bt horizon; profile has several long light gray tongues of (10YR 7/2) iron depletions that may be prismatic structural faces; soil materials at 11 inches are dense and compact with restrictive permeability; seeps at 10 inches around the pit walls; Profile 35 has moderately thick colluvium over Cr horizon beginning at 27 inches.

**Profile 36** is a Penn soil according to Sawyer and is on a gently sloping summit and shoulder with estimated 2 to 7% slopes; profile is in proposed primary install area; have redbed Cr horizon beginning at 20 inches with some seeps riding on top of the horizon

**Profile 37** is a Sowego soil in wheat stubble and is on the upper reaches of a broad upland drainageway with estimated slopes of 1 to 3%; Hatch is calling area a saddle, but drainageway fits water movement pattern better; Ap horizon is 10 inches thick; Cr horizon begins at 25 inches and free standing water is at 31 inches below the soil surface; many black manganese oxide coatings on rock faces; during the digging of the pit had 3 areas above the Cr horizon where groundwater spurted out of the pit walls; pit bottom rapidly filled with free water and we had to hurry to finish pit description.

**Profile 38** is Ott according to Sawyer and is on a backslope with estimated 2 to 10% slopes; profile in open mature hardwoods; soil color is grayish to brownish from top to bottom; parent rock is hornfel??; #1 Area is proposed for mostly drainfield reserve area; Profile 38 is described below by J. Sawyer

A—0 to 6 inches; dark brown (10YR 3/3) silt loam; moderate medium granular structure; 5% channers.

Bt1—6 to 15 inches; brown (10YR 4/3) channery silty clay loam; moderate medium subangular blocky structure; 30% channers

Bt2—15 to 24 inches; brown (10YR 4/3) very channery silty clay loam; moderate medium subangular blocky structure; 40% channers

Bt3—24 to 37 inches; brown (10YR 4/3) very channery silty clay loam; rock controlled structure; 50% channers.

Cr—37 to 48 inches; thermally altered siltstone; common manganese oxide coatings on rock faces; rock controlled structure

**Profile 39** is a good Jackland soil and is on a relatively flat, elongated summit with estimated slopes ranging from 2 to 7%; parent material is greenish diabase; has a Btss horizon beginning at 9 inches with high clay content texture; clays are very dense and firm and have high plasticity, very high shrink-swell potential and pronounced restrictive permeability; also has many gray (10YR 6/1) iron depletions; has a BCt/CBt horizon beginning at 31 inches that consists of clayey material intermixed with greenish diabase parent material; have abundant seeps in the Bt horizons; Profile 39 has 1% diabase cobbles on soil surface.

**Profile 40** is a good Jackland and is on a broad footslope with a measured 4% slope; profile is along the edge of mature hardwood forest; clay Bt horizon at 16 inches with clays that have high plasticity and very high shrink-swell potential; many seeps in the Bt horizons; dominant root growth is from 0 to 17 inches; have 1% diabase cobbles and stones on soil surface; Profile 40 has local colluvium/slope creep from 0 to 17 inches with many very pale brown (10YR 7/3) iron depletions; also has many black (7.5YR 2.5/1) manganese oxide concentrations and coatings; colluvial soil materials are moderately dense, compact, and brittle with weak platy structure; soil area mapped as 25C.

**Profile 41** is a good Jackland soil and is on a summit and high shoulder landform with estimated 2 to 7% slopes; has a Btss horizon from 7 to 24 inches that is clay texture with clay materials that are very plastic and have very high shrinks-swell potential and restrictive permeability; horizon also has common medium prominent grayish brown (2.5Y 5/2) iron depletions.

**Profile 42** is a Jackland or Haymarket soil and is on the lower part of a summit that merges into a wet saddle; estimated slopes are 2 to 7%; profile has a Btss horizon that has a clay texture; Btss clays have very high plasticity and very high shrink-swell potential; C horizon consists of diabase saprolite that textures to a clay loam when adequately worked in the hand; Profile 42 fits better as a Haymarket soil because it does not have the gray iron depletions like the Jackland soil; however, this soil is just as limiting as a Jackland soil because of the plastic, very high shrink-swell clays in the Btss.

**Profile 43** is a good Jackland soil and is on a partly convex and partly flat summit with estimated slopes of 2 to 7%; Jackland soil good example of igneous intrusion of diabase on this tract; profile described below by J. Sawyer.

Ap—0 to 4 inches; brown (10YR 4/3) loam; moderate medium granular structure  
Btss1—4 to 10 inches; dark yellowish brown (10YR 4/4) clay with slickensides; moderate medium sab structure  
Btss2—10 to 23 inches; dark yellowish brown (10YR 4/4) clay with slickensides;  
Btss3—23 to 32 inches; dark yellowish brown (10YR 4/4) clay with slickensides  
BCt—32 to 37 inches; yellowish brown (10Yr 5/6) and dark yellowish brown (10YR 4/4) heavy loam; massive.  
C—37 to 50 inches; yellowish brown (10YR 5/6) very dark grayish brown (10YR 3/2) light loam; massive

**Profile 44** is marginal Brecknock-like soil in the mature hardwoods; profile is on an elliptical footslope landform at the base of an igneous intrusion that has thermally altered the surrounding rocks to produce the Brecknock-like soil; profile has some features indicative of colluvium soil and appears to be deep colluvium overlying thermally altered siltstone; have subangular to subrounded diabase cobble at contact between dark yellowish brown (10YR 4/6) material and very dark grayish brown (10YR 3/2) material; Profile 44 is one of the deepest soil profiles evaluated so far; has about 30 inches of workable soil.

**Profile 45** is Ott-like to Penn-like and is derived from greenish thermally altered siltstone; profile is on a shoulder landform with estimated 2 to 10% slopes; profile has about 24 to 34 inches of workable soil.

**Hatch Note**—Area 10 is for primary drainfield installation

#### Summary of the Soil Features and Properties

The soils have a host of limitations for any proposed onsite wastewater treatment and disposal system. These limitations include the following: shallow depths to redoximorphic (wetness) features; shallow depths to weathered bedrock (Cr horizons); shallow depths to horizons and soil materials with restrictive permeability; shallow depths to very high shrink-swell clays; soils on marginal landforms, such as footslopes and toeslopes, saddle landforms, and other concave landforms.

The soils over the site have been thoroughly and decisively evaluated and documented by Danny Hatch (Project Soil Scientist, Dominion Soil Science, Inc.) and Jim Sawyer (Fauquier County Soil Scientist). In fact, the soil reports and soil data submitted separately by Hatch and Sawyer are easily the grandest and most comprehensive this writer has observed for any mass drainfield proposal. The 28 soil profiles evaluated in my soil report are mostly confirmations of what Hatch and Sawyer have already documented in their reports. During my soil and site evaluations with Hatch and Sawyer et al on March 2-3, 2010, I acquired a good, general overview of what the soils and landforms are like for the Village of Catlett project. One of the goals of my soil evaluation was to attach a soil series name (Penn, Jackland, etc) to each profile evaluated. This allows for the most comprehensive dissemination of soil information.

### Conclusions

Starting with the premise that the Village of Catlett (VOC) onsite wastewater treatment and disposal system will have to work well each and every day, and essentially forever, the project has serious soil limitations to overcome. The normal expectation for a project of this magnitude and complexity is that the soils will be the major ally in the treatment and dispersal of wastewater. In my opinion however, the VOC soils fall out as more of an adversary than an ally. A large project generating 400,000 gallons of wastewater per day needs good soils to work and work well forever. The VOC project does not have good soils for a drainfield, only marginal soils and bad soils such as Jackland, Haymarket, Very Wet Nestoria, Shallow Sowego, etc. As a field soil scientist I serve as a soil advisor to the Virginia Department of Health and provide soils advice on various projects. In regards to a simple yes or no on the feasibility and long term success of this project, I would have to vote no.

Conceptually, the Village of Catlett project is breaking new ground with the size and complexity of the project and the fact that the project is proposing to use an alternative onsite wastewater system (shallow drip) installed in consistently marginal and bad soils. This writer has evaluated several large developments that use mass drainfields, but none of these projects were as large as the Village of Catlett and for the most part they were installed in superior soils. The bottom line is that the Health Department has only a minimal frame of reference for the Catlett project in relation to its size and soil limitations. And while there are definitely soils at the Catlett project that meet the Virginia Sewage Handling and Disposal Regulations (2000) for an alternative drainfield, it remains a very risky and adventurous proposition to cram 950 residential lots and 95,000 sq. ft. of commercial occupancies into the marginal and bad soils at the site.

It is duly noted that during the March 2-3, 2010 soil and site evaluations there was plenty of free water in the soils, backhoe pits, and on the soil surface. Many of the soil profiles had free water seeping out of the backhoe pit sidewalls. Most of the soils were probably at their maximum (and beyond) in holding groundwater derived from the slow, sustained melting of snow. As with most areas in Virginia, the local area and region had received more than 4 feet of snow according to Hatch. Therefore, in some respects it is not "fair" to come down too hard on the Village of Catlett soils because they were trying to absorb and transmit an excessively high amount of groundwater derived from more than 4 feet of snow. Conversely, the flip side of this argument would say that this was an excellent time to evaluate the Catlett soils because we can see how the soils will behave and function under high amounts of groundwater and future wastewater. A comprehensive approach to these two dichotomies is to document free water levels and any and all redox features in the soil profile and try to determine if the free water can be correlated with the redox features, such as chroma 3 or 4 iron depletions or red and yellowish red iron concentrations. The observed redox features will be of the most importance in determining how the soils historically absorb and transmit groundwater. The bottom line is the Catlett soils had plenty of free water and redox features in the soils.

All along the project consultants (Burkes and Hatch) have clearly indicated the Village of Catlett project will be submitted as a House Bill 1166 project. House Bill 1166 projects require the Virginia Department of Health to accept designs for onsite treatment works (onsite sewage systems) from individuals licensed as professional engineers (PE). House Bill 1166 projects are guided by Health Department GMP 146. The first page of GMP 146 is included in this soil report and the entire GMP 146 defines how the Village of Catlett project can proceed to the next level.

Soil Report By:



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